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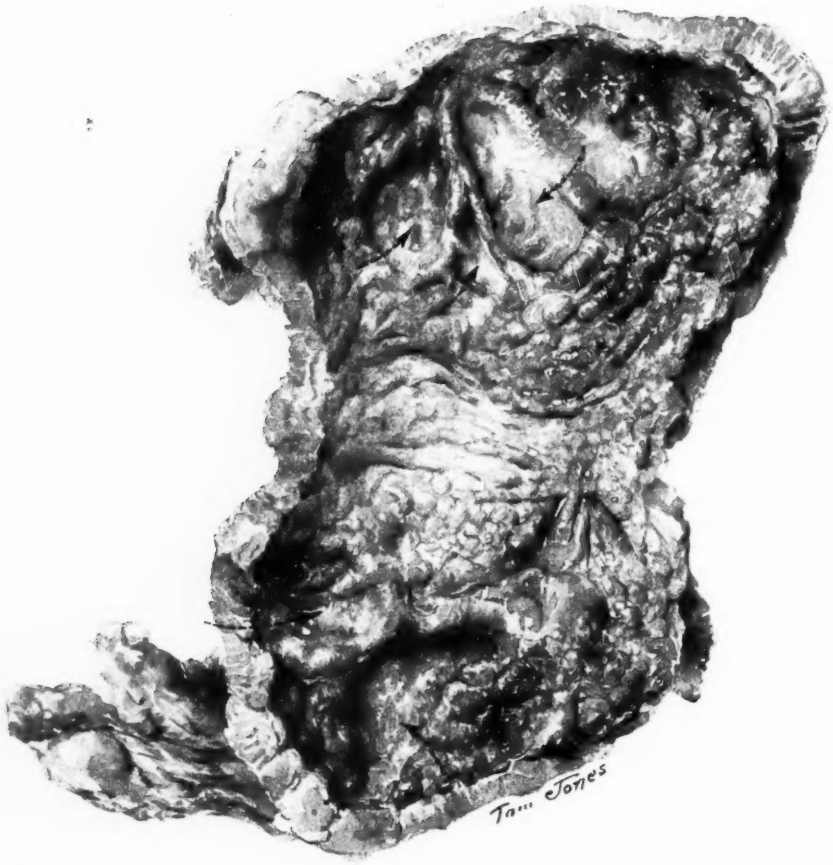

Fig. 1. Resected pyloric portion of stomach from Case 1. Walls thickened and five ulcers indicated by arrows.

Gastric Syphilis; a Report of Two Cases Proved Anatomically.
—William A. Brams and Karl A. Meyer.

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GASTRIC SYPHILIS; A REPORT OF TWO CASES PROVED ANATOMICALLY[1]

BY WILLIAM A. BRAMS, M.D., CHICAGO
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ACQUIRED syphilis of the stomach, anatomically proved, may be considered a rare disease if one is to judge the incidence by the number of reports of such cases in the literature. Thus, we were unable to find more than 14 cases in which the anatomical reports were sufficiently complete to warrant a diagnosis of gastric syphilis. Among those usually accepted as proved syphilis of the stomach are the cases of Flexner (6), Hemmeter and Stokes (11), Fraenkel (8), Curtis (16), Chiari (23), Klebs (66), Cornil and Ranvier (67), Weichselbaum (68), Birch-Hirschfeld (69), Stolper (64), Buday (13), Sparmann (70), and McNee (71).

This rarity may, however, be more apparent than real for the modern methods of specific treatment have undoubtedly cut short the course of tertiary syphilis in the stomach as elsewhere in the body. Another reason may be that the condition may have been mistaken at the operating or postmortem tables for carcinoma or chronic calloused ulcer of the stomach.

This supposition is supported to a certain extent by the fact that the number of cases of gastric syphilis reported and in which the diagnosis was based solely on clinical or serological evidence has been much greater, especially in the past few years. The exact number of such reports cannot be given but a fair estimate would be about 250.

On the other hand, we must not be led into making a diagnosis of gastric syphilis simply because there is a digestive disturbance coexisting with a positive Wassermann or evidence or a history of syphilis elsewhere in the body. Such a coincidence may be purely accidental especially if we consider a verbal statement made by Professor Finger that about 10 per cent of the population of Vienna would give evidence of luetic infection in the form of a positive Wassermann, history or symptoms of lues. This figure may not apply in certain instances but the example is well worth remembering.

It is, therefore, with the view of emphasizing the clinical and anatomical characteristics of gastric syphilis that these two cases of anatomically proved lues of the stomach are reported.

CASE 1. E. G., female, white, age 25, married, was admitted to the Cook County Hospital on July 7, 1922. The patient's family history was negative; she had never been pregnant, and she denied venereal infection. She was well up to about 3 months ago when she began to complain of dyspnœa, palpitation, swelling of the ankles, pain in the chest and abdomen, and marked loss of weight.

[1] Read before the Chicago Surgical Society, April 6, 1923. (For discussion, see p. 240.)

Fig. 2. Cut section of specimen removed from Case 2 showing thick submucosa and shallow ulcer.

The abdominal pain was in the midline, dull or aching, came on about 5 minutes after eating and lasted for about half an hour. Bowel movement had no effect on the pain. The pain soon became more constant but was still worse after meals regardless as to whether she took liquids or solids. Alkalies had no distinct effect and vomiting was the only thing which relieved her. Bodily motion did not increase the pain nor did it radiate in any direction. She lost about 25 pounds in the first 2 months and a good deal more in the following month. She was dizzy at times and frequently had nausea.

Vomiting occurred for the first time about 2 months ago and was chiefly after meals. Large quantities of a bitter, dark brown substance were vomited but never any blood. She also had eructations and belching. She soon noticed that her abdomen became large and that she could induce vomiting by pressing on her epigastrium. She did this to relieve the pain. Anorexia and constipation were also present but there was never any jaundice.

The examination showed a poorly nourished female, very much emaciated and very ill. The pupillary reflexes were normal, and there were signs of a double mitral lesion and aortic insufficiency. The reflexes were normal and the urine contained a trace of albumin and a few hyaline casts. The Wassermann of the blood was strongly positive.

There was a tender bulging in the right hypochondrium, and pressure over this produced vomiting. A sausage-shaped mass was palpated in the epigastrium. Aspiration of the stomach contents caused the bulging to disappear and inflation of the stomach again brought out the tumor.

Examination of the stomach contents after an Ewald meal showed 600 cubic centimeters of residue; free hydrochloric acid 0, total 30; some mucus and occult blood. The stools were tested four times for blood under the usual precautions and with the benzidine test, and were positive in all instances. There was a leucocytosis of 15,100.

X-ray examination showed a large 6-hour residue and no barium had entered the bowel. Only the proximal part of the stomach showed a shadow with a blunt interruption at the pars media. Rotation of the patient to a semi-prone position aided the remainder of the stomach to fill, but the pars media did not fill out even with this change in posture.

Syphilis of the stomach was suspected, but there was also a strong suspicion that the condition might be malignant. She was operated upon for the existing obstruction and for a possible resection of the involved part. About one-third of the stomach was resected, including the entire infiltrated pyloric portion, and a Billroth II operation was performed as there were no adhesions and the adjacent glands were but slightly enlarged. She was also placed on specific treatment. The patient was seen about 2 months after operation. She felt well and had gained 30 pounds.

The anatomical features of this case will be discussed together with those in Case 2, except to point out the differences which were only in degree of the same changes.

CASE 2.[1] J. M., male, age 51, married, clerk. Admitted to the Allgemeines Krankenhaus, Vienna on November 26, 1920. Family history negative. Patient had chancre on penis at age of 25 which was treated as syphilis, but for a short time. Digestive disturbances began about 3 years after infection and consisted of burning pains in the epigastrium with radiation upward. The pain came on about an hour and a half after meals and lasted about 4 hours. Occasional pain occurred at midnight and could not be relieved by any measures.

Vomiting was infrequent at first but later occurred daily. The vomitus was about 500 cubic centimeters and contained food but no blood or retained stomach contents. Vomiting was the only thing which relieved the pain in the later stages. Anorexia, constipation, and marked loss of weight were also noted.

Examination showed a markedly emaciated male, no fever, and no abnormal findings in the chest. Ewald test meal, removed 25 minutes after ingestion, showed: quantity, 150 cubic centimeters; free hydrochloric acid 0, total acidity 2; no blood or lactic acid. The abdomen was tender in the upper part but no tumor was palpated. The knee jerks were absent and he had an Argyll-Robertson pupil.

X-ray examination showed a 6-hour residue of about half of the barium meal. The stomach was normal in position, not dilated. There was pyloric insufficiency. The pyloric portion resembled a narrow canal about as thick as a lead pencil and with ragged margins. No tenderness was present at the pylorus or duodenum and the latter had normal outlines. The condition was thought to be carcinoma. The pyloric portion was resected and a Billroth I operation performed.

A Wassermann taken after operation was strongly positive. The stools were examined for blood but the results were indefinite. The diastase content in the serum, urine, and stools was normal, and there was a white count of 29,600.

[1] Reported in Arch. f. Verdauungskr., 1921, xxvii, Sept. 6.

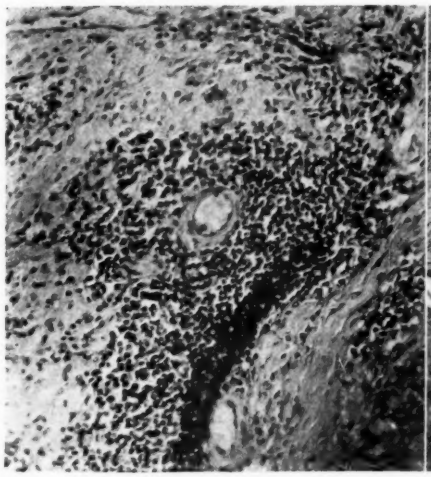

Fig. 3 (at left). Perivascular infiltrate consisting chiefly of lymphocytes and a few plasma cells. Hæmatoxylin-eosin stain.

Fig. 4. Pan-arteritis and pan-phlebitis with complete obliteration of lumen of vein and almost complete obliteration of the arterial lumen. Marked change in the adventitia of the artery. Weigert elastic tissue stain.

The anatomical features of the resected specimens showed the characteristic changes which allowed a strongly presumptive diagnosis to be made at once. These were the *thickened submucosa; shallow, multiple, and irregular ulcers*, and the presence, in Case 2, of visible ***miliary gummata***.

The entire pyloric portion of the stomach was thickened and infiltrated. Case 1 showed 5 shallow, irregular ulcers on the anterior and posterior walls, while Case 2 had only 3 such ulcers on the posterior surface. The maximal diameters of the smallest ulcer were 15 by 5 millimeters and 35 by 10 millimeters in the largest. The average depth was 2 millimeters and the comparatively smooth, dark red base stood out in relief against the pale gray surrounding mucosa. The margins were somewhat raised and thickened but there was no necrosis or caseation anywhere.

The cut section showed the submucosa to be thickened to about eight times its normal size in the region of the ulcers and normal beyond them. This layer was pearly gray, of rubbery consistency, and Case 2 showed small pinpoint miliary gummata. At no place in either specimen did the ulcer go deeper than the more superficial part of the submucosa.

Numerous slides were stained with hæmatoxylin-eosin, Weigert, Van Gieson and stains were made for bacteria with Gram and methylene blue, and stains for tuberculosis bacilli were made. The Levaditi method was used in the search for the treponema pallida.

The microscopic examination showed that all of the important changes were chiefly in the submucosa and that the thickening of this layer was due to the connective tissue proliferation, round cell infiltration and œdema. It was the œdema which was the principal factor in the thickening of the submucosa in Case 2.

The chief features seen on microscopical examination were:

Perivascular infiltrate which consisted chiefly of lymphocytes and a few plasma cells. There were many vessels involved in this manner, regardless of size, and both the veins and arteries were affected. Case 2 differed in that the vessels which showed changes in their walls were not so often seen to have this perivascular infiltrate.

Pan-arteritis and pan-phlebitis, described by Fraenkel and considered by him to be highly characteristic of this condition, if associated with such other changes as an infiltrate,

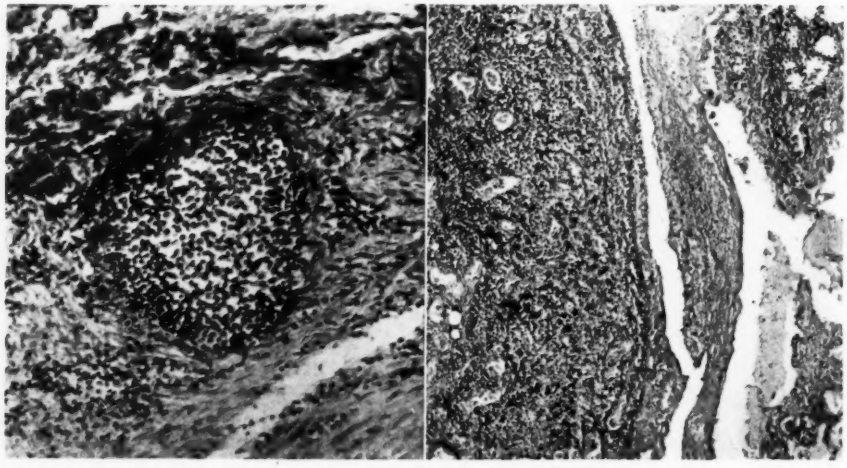

Fig. 5 (at left). Miliary gumma in muscular layer consisting of lymphocytes and a few plasma cells on a framework of delicate connective tissue and containing a few capillaries. Some epithelioid cells near periphery. No necrosis or caseation.

Fig. 6. Ulcer base showing diffuse infiltrate of lymphocytes and coat of fibrin enclosing some leucocytes and débris.

etc., were present. The process evidently began in the outer layers of the vessels and then attacked the media and intima. The earliest changes were a teasing apart of the elastic fibers of the adventitia with infiltration by round cells. The media was next affected and then the intima but this layer did not show the tearing apart of the elastic fibers to the same degree as did the adventitia. Fibrosis then occurred and the vessel became permanently changed. The lumen became narrowed and in many instances completely obliterated during the stages of infiltration and fibrosis. It is interesting to note that the vascular involvement was in patches and did not affect the entire circumference. The changes in the veins were probably the cause of the marked œdema of the submucosa, but it is curious that there was no necrosis in the presence of the extensive arterial changes. The pan-arteritis was not so marked in Case 2, and only a moderate degree of endarteritis was present in this case, but not any more than in ordinary peptic ulcer or in the vicinity of any other chronic inflammation.

Both specimens contained miliary gummata, the number in Case 2 being much greater than in Case 1. These were located chiefly in the submucosa but some were present in the muscular layers as well. This change consisted of a circumscribed collection of cells, chiefly lymphocytes but also a few plasma cells at the periphery. Both elements rested on a fine connective-tissue framework and an occasional capillary was seen within the gumma. The whole was surrounded by a thin connective-tissue capsule but there was no marked vascular reaction in the vicinity nor were there large vessels near by. This was quite distinct from the other forms of infiltrate, and no necrosis or caseation was present. A few epithelioid cells were present near the periphery, and Case 2 showed one with a giant cell of the Langhans type.

The diffuse infiltrate consisted chiefly of lymphocytes and a few plasma cells with an occasional giant cell. A few polynuclears were present near the surface. The infiltrate was very extensive and was found chiefly at the base of the ulcer. There were many capillaries and a number of extensive hæmorrhages, especially near the mucosa. This collection of free blood was seen at one place to lift off the overlying mucosa. This may have been one of the factors in the formation of the ulcer.

Other and less important changes were a round-cell infiltration of the interstitial tissue of the mucosa with occasional hæmorrhage. A coat of fibrin containing some leucocytes and d bris covered the base of the ulcer. The muscular layers showed evidences of fibrosis and slight round-cell infiltration, and the peritoneum was practically normal. Both specimens showed an occasional round-cell infiltration around the nerves in the muscular layer. This may, perhaps, be one of the causes for the pain.

A careful search was made for spirochætæ but none was found. This does not speak against the diagnosis, as it is well known that the causative organisms are seldom found in tertiary lesions. McNee (71) described changes very similar to those in these specimens and in which he demonstrated spirochætæ in the submucosa very closely resembling the treponema pallida.

There were a few long, Gram positive bacilli and Gram positive cocci at the surface of the ulcer but no tuberculosis bacilli were found.

A study of 135 additional cases selected from the literature was then undertaken with a view of establishing a clinical picture. This series included the 14 cases proved anatomically and those in which the diagnosis, when based on clinical findings alone, seemed fairly certain.

According to Bensaude (72), there are four types: ulcerative, tumefactive, linitis type, and stenosing type. The nature of the underlying pathology will determine the type and the resulting symptoms, but there are clinical manifestations which are common to all forms and which will be briefly described.

Pain in the epigastrium with occasional radiation was present in all but three instances (29, 73, 74) and was the most frequent and important symptom. It was usually severe and became worse after meals, but all varieties and degrees were noted. The pain was at first relieved by alkalies but subsequently only vomiting gave relief. The most frequent type was boring or burning and it was constant in many instances.

Anacidity and marked *subacidity* were found in 50 of the 93 instances in which the stomach contents were examined and reported. This was present in both of our cases.

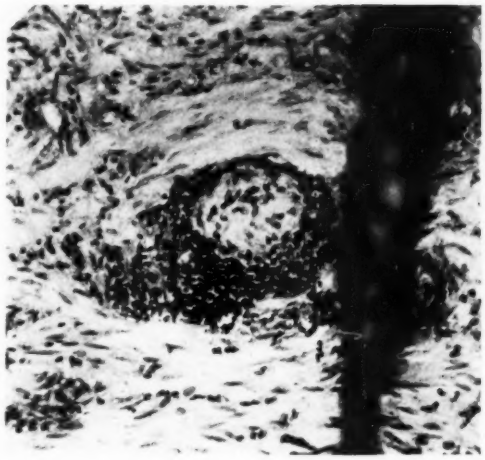

Fig. 7. Perineural infiltrate of round cells in muscular layer.

Emaciation was usually marked, the average loss being from 30 to 40 pounds, and one author reported a loss of 75 pounds. This sign was present in 88 per cent of the cases. A marked anæmia often accompanied the emaciation and often gave rise to the impression that there was cachexia.

It is difficult to determine the actual rate in which there was *evidence of luetic infection*, as many of the cases were reported in the days before the Wassermann came into use. The Wassermann test was reported in 89 cases and was positive in 96 per cent, the great majority being 4+. There were 9 additional cases in which no Wassermann was reported but in whom positive evidence of syphilis was found. Two instances are reported in which the Wassermann was negative in spite of the fact that the condition was syphilis, as proved by other clinical evidence and the results of specific treatment (75, 76).

Reaction to *specific treatment* is especially characteristic if previous management has failed. There were 125 reports in this regard and the results were: clinical cure in 60 per cent, improvement in 33 per cent, and failure in 7 per cent. There were some cases in which the contour of the stomach, as seen on X-ray

examination, returned to normal and a few instances in which a previously anacid gastric juice returned to normal after specific treatment.

The findings on X-ray examination varied to a great extent and were usually very much like those found in carcinoma. Signs of obstruction and filling defects were the chief features, but it is difficult to point out changes which are pathognomonic of syphilis.

The other and less characteristic symptoms were hæmatemesis, constipation, vomiting, tenderness in the epigastrium, large liver and blood in the stools. These were not found in a sufficiently large number of instances to warrant particular attention as characteristic of gastric syphilis.

RÉSUMÉ

The clinical evidence of gastric syphilis consists of pain in the epigastrium, low acidity, marked emaciation, history or evidence of luetic infection, and a good result with specific treatment. To this should be added that the patient is often under the usual age for carcinoma and that the course is often over a period of years.

The anatomical features are multiple, irregular ulcers; thick submucosa; vascular changes; miliary gummata; perivascular infiltrate; and diffuse infiltrate, in which the predominating element is the lymphocyte.

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SYPHILIS OF THE STOMACH[1]

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SYPHILIS of the stomach shares with syphilis of other viscera the difficulty of final differential diagnosis. Active syphilis, as evidenced by clinical manifestations other than gastric or by a positive Wassermann reaction, is suggestive of that etiology of a coincident gastric syndrome.

The literature recently has contained exhaustive summaries of the reports of gastric syphilis. Those of Eusterman (1), Fowler (2), and Morgan (3), review adequately the previous literature. Eusterman states: "The symptomatology which is fairly characteristic of gastric syphilis is suggestive of benign gastric ulcer, and the gastric chemistry and roentgenological findings suggest carcinoma." He says also that if both the anamnesis and the Wassermann are negative, the possibility of gastric syphilis is not excluded. Morgan states: "A diseased condition of the stomach marked by a long duration with changeable symptoms which do not correspond to one or the other of the well-recognized diseases of that organ, and which resist the accepted methods of treatment, should arouse suspicion" (of syphilis).

Gastric syphilis has no characteristic clinical picture. The facility with which syphilis imitates disease of other etiology is very evident in gastric syphilis. Different types and stages of gastric syphilis present markedly different pictures. A clinical course, unusual to that of the suggested disease, gives the clue. With all possible data the diagnosis is made in large part by exclusion.

CASE 1. P. C., white, age 32, married. Patient has been ill 4 months. Onset was sudden, following a large meal. The pain begins 30 minutes after a meal and increases in intensity until vomiting results in about 2 hours. Vomiting gives relief. Patient has lost in weight and strength. Physical examination revealed nothing of note except the loss of weight and a point of tenderness in mid-right epigastrium. There was no palpable mass. Laboratory tests showed a positive blood Wassermann; achlorhydria.

[1] From X-Ray Department, Medical School, Washington University.

Fig. 1. The filled stomach shows the prepyloric lesion. (Case 1.)
Fig. 2. The stomach at 6 hours shows much residue. There was marked motor impairment. (Case 1.)
Fig. 3. The stomach (prone position) at 24 hours, shows much residue. This results from the great motor impairment. (Case 1.)
Fig. 4. The stomach, postoperative, shows adequate functioning of the gastrojejunostomy. (Case 1.)

No occult blood was found in the stools. X-ray examination showed marked gastric motor insufficiency due to a prepyloric lesion which was highly suggestive of syphilis.

At operation a gastric resection and gastrojejunostomy was done by Dr. Ellis Fischell, who considered the condition luetic. Antiluetic treatment was begun. The clinical result was perfect.

The microscopic report (Dr. M. T. Burrows) was: chronic inflammation. Gumma. (Figs. 1, 2, 3, 4.)

Case 2. E. B., colored, age 30, married. The illness was intermittent and variable during 5 years. Vomiting occurred immediately after eating and infrequently the vomitus showed food residue from the previous day. There was loss of weight from 137 to 101 pounds in the previous 4 months. Physical examination showed nothing important except loss of weight. Laboratory tests showed positive blood Wassermann; marked gastric hypoacidity; and the stool contained no occult blood.

After a 7 months' disappearance and without antiluetic treatment she gave a similar clinical picture, but with more frequent vomiting and this more often with residual food. X-ray examination now showed a lesion involving the prepyloric stom-

Fig. 5. The stomach, partially filled, shows a prepyloric lesion. It was not palpable. (Case 2.)

Fig. 6. Hyperperistalsis is shown. (Case 2.)

Fig. 7. The stomach, postoperative, shows adequate functioning of the gastrojejunostomy. (Case 2.)

Fig. 8 (at left). The stomach shows the prepyloric lesion. It was not palpable.
Fig. 9. The stomach 3 months after observation in Figure 8. (Case 3.)

ach with resulting organic motor insufficiency. The lesion was considered luetic. It was not palpable.

A gastric resection and gastrojejunostomy was done by Dr. E. A. Graham. A small tumor the size of a hazel nut and having a flat base was found to obstruct the pylorus.

The microscopical diagnosis was chronic inflammatory disease. No carcinoma could be found. X-ray examination showed admirable postoperative conditions of the remaining stomach and stoma, and the clinical result was excellent.

CASE 3. E. P. G., white, female, age 31, married. The duration of the illness was 8 years. Vomiting occurred seldom, perhaps once a month, and then immediately after meals, and was not associated with pain. More frequent attacks had occurred during previous 2 years, and each had continued 10 to 14 days and with persistent vomiting. There was severe gastric hæmorrhage twice. Loss of 80 pounds in weight had occurred in the year previous.

Physical examination showed nothing of note except for the evidence of loss of weight. Laboratory tests showed positive blood Wassermann; gastric hypochlorhydria. The vomitus gave a positive occult blood test, the stool gave a positive occult blood test. X-ray examination showed gastric motor insufficiency due to a high-grade annular filling defect involving distal pyloric stomach, characteristic

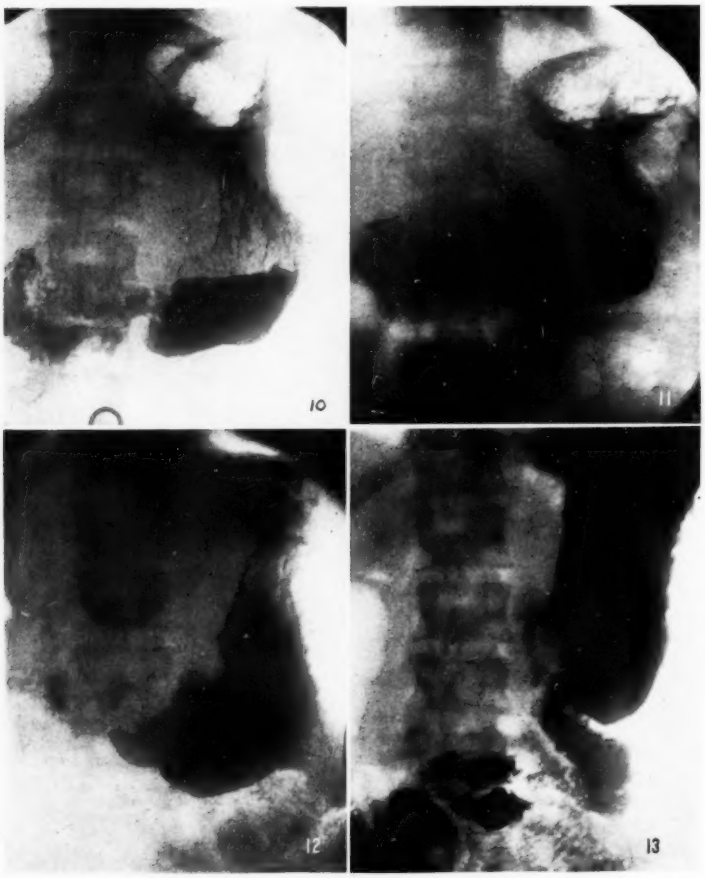

Fig. 10. The stomach shows a prepyloric deformity. There was no palpable mass. (Case 4.)

Fig. 11. Fourteen months after observation shown in Figure 10. (Case 4.)

Fig. 12. The stomach, postoperative, shows adequate functioning of the gastro-enterostomy. The prepyloric deformity persists. The case was not benefited clinically. (Case 4.)

Fig. 13. The stomach (after second operation) shows condition after prepyloric resection. The gastro-enterostomy was not altered. The patient was greatly improved. (Case 4.)

of carcinoma, however, without palpable mass or tenderness. The lesion was possibly luetic. Second X-ray examination 3 months later was essentially the same.

At operation (Dr. E. A. Graham) the stomach wall was found thickened. There was no pyloric stenosis. Appendectomy was done. Pieces of stomach were excised for histological examination. Microscopical examination of the mucosa and the stomach wall showed chronic inflammatory disease and chronic atrophic gastritis. The mucosa was thinner than normal. The outer border was infiltrated with small and medium sized mononuclear cells and typical polyblasts and plasma cells and scattered polymorphonuclears.

This patient improved somewhat under antiluetic treatment. Observation of the condition was terminated by death of the patient following an abortion.

CASE 4. W. R., male, colored, age 22, married. The illness was of 5 years' duration, with periods of acute exacerbation. Vomiting occurred frequently

Fig. 14. Ulcer crater shows on lesser curvature. (Case 5.)

Fig. 15. The stomach at 6 hours shows much residue. There was a high-grade motor impairment.

Fig. 16. The stomach, postoperative. shows an adequately functioning gastro-enterostomy. (Case 5.)

and relieved pain. He had noted food of day previous in the vomitus. The pain was located in the left upper quadrant and occurred immediately after drinking or eating, and especially during the night. It was relieved by vomiting. Venereal disease was denied. Physical examination showed nothing of note. There was no palpable abdominal mass. Laboratory tests showed negative blood Wassermann on three occasions, negative spinal fluid Wassermann; slight gastric hypochlorhydria. The stool contained no occult blood. X-ray examination showed a superficial lesion involving the prepyloric stomach and of a type suggesting luetic ulceration.

The case was observed on dietetic and antiluetic treatment for 8 months without notable change. He could not at any time care for a full and rough diet. Vomiting with residual food invariably resulted. The barium X-ray meal showed good total motility. X-ray re-examinations gave the same findings as originally.

A gastric enterostomy was done by Dr. E. A. Graham. Only thickening of prepyloric region was noted. A pathological appendix was removed.

X-ray examination, 16 days postoperative, showed a freely functioning gastro-enterostomy stoma, and there was no evidence of repair of the lesion of the pars pylorica. The subsequent course was little different than prior to operation and after approximately 1 year a second operation was done by Dr. Graham with resection of the stomach distal to the gastro-enterostomy. The resected stomach showed increased thickness and firmness. Microscopical sections showed an increase of fibrous tissue in all layers. The subsequent clinical course has been good since the gastric resection.

Case 5. M. A. H., white, male, age 39, single. The duration of illness was 5 years. Vomiting occurred after meals. Antiluetic treatment and appendectomy had improved the symptoms. The recent acute illness was characterized by abdominal cramps, nausea, and vomiting soon after meals. The vomitus was of large amount; old food was not noted. There was a loss of 23 pounds in weight in 10 weeks. Physical examination showed advanced central nervous system syphilis. The abdomen showed an appendectomy scar, rigidity and tenderness in epigastrium, and a palpable flat mass in the left epigastrium size of pigeon's egg. It had no definite respiratory excursion. Gastric lavage gave 1000 cubic centimeters of residual fluid. The occult blood reaction was strongly positive. X-ray examination showed organic gastric motor insufficiency due to a penetrating ulcer of lesser curvature.

At operation Dr. E. A. Graham did a posterior gastro-enterostomy. The lesion was found firmly adherent to contiguous structures and was considered non-malignant. The omentum showed numerous small tubercles. A piece of stomach wall showed microscopically chronic inflammatory change. The postoperative X-ray examination showed prompt gastric motility. Gastro-enterostomy stoma functioned admirably. The gastric ulcer "crater" persisted, although it had decreased in size and was more shallow than at the initial examination.

This case had received treatment for central nervous system syphilis and not until a palpable mass appeared had the possibility of an organic gastric pathology been considered. Tabetic crises had explained the pain. The rarity of true gastric crises without any organic pathology in the stomach is becoming more and more evident with the more frequent use and the greater accuracy of the direct

Fig. 17 (at left). The stomach shows hypertrophic rugæ and distortion of the prepyloric portion. (Case 6.)

Fig. 18. The stomach shows distortion of prepyloric portion. There was no palpable mass. Motility was normal. (Case 6.)

diagnostic approach of roentgenology. Mills (4) states that he has never failed to find evidence of an organic lesion in all cases of so-called gastric crises in eight thousand or more gastro-intestinal X-ray examinations.

CASE 6. O. H., white, age 28, married. The duration of the illness was 4 months, and had become progressively worse. There was a burning sensation in the left epigastrium associated with nausea, but without vomiting. There was a loss of 14 pounds in weight. Physical examination disclosed only slight

TABLE I.—SUMMARY OF CASES

Case No.	Age	Duration	Weight Status	Pain	Vomiting	Wassermann	Gastric HCL	Occult Blood, Stoon	Palpable Abdominal Mass	X-Ray Findings	Type of Operation	Antiluetic Treatment	Microscopic Pathology	Clinical Result
1	32	More than 4 mos.	Loss	Soon p. c.	2 hrs. p. c. relief	Pos.	o	o	o	Prepyloric lesion, luetic, stenosis	Resection		C. I. Gumma	Good
2	39	5 yrs.	Loss 36 lbs. 4 mos.	None ?	Immed. p. c. relief	Pos.	H.	o	o	Prepyloric lesion, luetic, stenosis	Resection		C. I.	Good
3	31	8 yrs.	Loss 80 lbs. in 2 yrs.	None	Immed. p. c.	Pos.	H.	Pos.	o	Prepyloric lesion, luetic, stenosis	Resection		C. I. Gumma	Good
4	22	5 yrs.	Loss	Immed. p. c.	Soon p. c. relief, residue noted	Neg.	H.	o	o	Prepyloric contractive lesion, good motility	Gastro-enterostomy			Poor
											Later Resection			Good
5	39	5 yrs.	Loss 23 lbs. in 3 mos.		Soon p. c.	Pos.		o	Pos.	Impaired gastric motility ulcer	Gastro-enterostomy			Good
6	28	4 mos.	Loss 14 lbs.	None	Soon p. c. relief	Pos.	H.		o	Good gastric motility		Plus		Good
7	49	3 yrs.	Loss in 4 mos.	Immed. p. c.	Soon p. c. relief	Pos.	H.	o	o	Good gastric motility		Plus		Good
8	39	9 yrs.	Loss 12 lbs. in 1 yr.	Immed. p. c.	Soon p. c. relief	Pos.			o	Prepyloric lesion, stenosis, luetic				

H. = Hypochlorhydria. o = None. Blank = No observation. p. c. = After meals. C. I. = Chronic inflammation.

Fig. 19. The stomach shows hypertrophic rugæ. (Case 7.)

Fig. 20. The stomach shows hypertrophic rugæ. This observation was 13 months after that of Figure 19.

Fig. 21. The stomach shows hypertrophic rugæ. This observation was 14 months after that of Figure 20.

tenderness in left hypochondrium. Laboratory tests showed positive blood Wassermann on two occasions; and gastric hypochlorhydria. X-ray examination of the stomach showed hypertrophic rugæ suggestive of an inflammatory reaction. There was no improvement on an ulcer treatment of diet and alkaline medication. There was prompt relief of symptoms and gain in body weight on antiluetic treatment.

CASE 7. M. V., colored, age 49, married. The illness was of 4 months' duration. The chief symptoms were precordial pain and an inability to eat rough foods without epigastric pain and vomiting. He had had similar trouble previously, but never so severely or persistently. Physical examination showed evidence of marked loss of weight, signs of central nervous system syphilis, and signs of aneurysm of the aortic arcus. The abdomen showed a slight tenderness in the right upper epigastrium. Laboratory tests showed positive blood Wassermann and moderate gastric hyperchlorhydria. There was no occult blood in the stool. X-ray examination showed an atypical contour and rugæ of distal stomach. There was an aneurysm of the arch of the aorta.

Mercurial treatment relieved all gastric symptoms, and the patient could take a full general diet. There was a prompt gain in weight.

CASE 8. M. B., colored, age 39, married. The illness was of 9 years' duration. The chief symptoms were epigastric pain, which was worse immediately after eating. It caused vomiting, which gave prompt relief. There was a loss of 12 pounds in weight during the year. Physical examination gave a moderate tenderness in the right hypochondrium and in the right lower quadrant. There was no palpable abdominal mass. Laboratory tests showed positive blood Wassermann. X-ray examination showed a prepyloric lesion resulting in pyloric stenosis of high grade. The lesion was not palpable.

These cases fall into a group definitely separated from other gastric disease. The final proof of their luetic etiology, namely, the demonstration of the spirochæta pallida, is lacking. In some the picture of gumma and of perivascular changes are highly presumptive of the histopathology of syphilis.

Five cases may be grouped as all showing gastric motor impairment. In these the duration of illness had been from 1 to 9 years. Loss of weight had occurred over a period of from 3 months to 1 year. Duration of loss of weight probably coincides with duration of gastric motor impairment. In all, vomiting occurred immediately or soon after eating. Hydrochloric acid was lacking or markedly reduced in all. The vomitus in two cases had shown food stasis in the stomach. Pain was variable and not characteristic. Only one case showed occult blood in the stool, and only one case failed to show a positive Wassermann. Four of these cases (1, 2, 3, and 8) had clinical and X-ray evidence of pyloric obstruction. One other (Case 4) had clinical, but not X-ray, evidence of the same. None had a palpable abdominal mass. The X-ray picture in each case was that of a prepyloric lesion, which was not characteristic of carcinoma or of prepyloric ulcer.

Most pyloric obstructions are the result of cancer, prepyloric ulcer, or of duodenal ulcer. Yet the age incidence, the duration of the ill-

Fig. 22. The stomach shows prepyloric lesion. It was not palpable. (Case 8.)

Fig. 23. The stomach, at 6 hours, shows large residue. There was marked gastric motor impairment.

Fig. 24. The stomach, at 24 hours, shows large residue. There was great motor impairment.

ness, the failing nutrition without cachexia, the occasion of vomiting early in the digestive cycle, and the absence of palpable abdominal findings and of occult blood in the stool, each questions, and all together cast great doubt upon a diagnosis of cancer Prepyloric ulcer is poorly supported by the ensemble of the clinical findings. The X-ray picture is not that of the usual prepyloric ulcer.

Four cases were operated upon. Three received gastric resections and yielded excellent clinical results. The fourth had a resection at a secondary operation and gave a good clinical result. This case was the only one of this group which showed good gastric motility by X-ray examination, although showing clinically a food stasis. Graham (5), in writing on the surgery of syphilis of the stomach, has summarized all reported cases operated upon for gastric syphilis, and shown that the clinical result is uniformly remarkably better after resection than after simple gastro-enterostomy.

The microscopical pathological report in two cases was gumma, and in the two others was chronic inflammatory disease.

Cases 6 and 7 gave histories and findings very similar. One only showed vomiting and pain. Neither gave clinical or X-ray evidence of impaired gastric motility. Both has positive Wassermann reactions. Their clinical response to antiluetic treatment was excellent.

CONCLUSIONS

Consideration of these cases in connection with the previous literature emphasizes the following points:

1. Gastric syphilis manifests a variable symptomatology, a chemistry, and X-ray findings that cannot consistently be of other well-recognized gastric disease.

2. The presence elsewhere of other undoubted signs of syphilis is a very large support to the diagnosis of syphilis of the stomach, and when absent great care must be used in making that diagnosis.

3. Successful medical treatment is diagnostic only in early gastric syphilis. Restoration to normal gastric motility cannot be expected in well-advanced gastric syphilis. The clinical response to antiluetic treatment will not then be helpfully diagnostic.

4. Surgery is indicated in late cases with permanent impairment of the gastric motor function. It is indicated by the clinical course and by the X-ray findings. Resection of the prepyloric stomach is the preferred operation.

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LUETIC OBSTRUCTION OF THE ŒSOPHAGUS

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TERTIARY syphilitic lesions of the œsophagus are very rare. This disease was first described in the middle of the eighteenth century. Wile (1) reviewed the literature and reported a case on this subject in a very excellent paper in 1914. According to him, up to 1906, only thirty authentic cases had been collected in all the literature, by Gaston. Since Wile's publication no reports can be found in the *Index Medicus*, the *Quarterly Cumulative Index of the American Medical Association*, and the *Index Catalogue* of the Surgeon General's Office except one case by an Italian author in 1915.

Tertiary syphilitic lesions of the other thoracic organs, however, are not so infrequent. The occurrence of aortic aneurism, gumma of the heart, lesions of the respiratory organs, the mediastinal lymph glands, and of the sternum are examples. Involvement of the mucous membranes of other parts of the gastro-intestinal tract in luetic infections is more common. The mouth, the tongue, and the rectum have been recognized for a long time as sites for tertiary manifestations of syphilitic disease. More recently tertiary lesions of the stomach have been investigated and found to be not as infrequent as was formerly supposed. Many cases had been confused with gastric cancer, and it is likewise possible that some of the cases of œsophageal obstruction might have been of luetic origin.

The local pathology of the lesion is similar to the disease elsewhere, producing one or more gummata of the submucosa with ulceration and resulting contraction and narrowing of the lumen. The process may be localized or diffused, single or multiple, of varying degree. There is dilatation of the œsophagus above the site of obstruction. The mediastinal lymph glands may be involved and enlarged appreciably. Three cases, including Wile's, were of the diffuse type. Syphilitic œsophagitis that occurs as a secondary manifestation of the disease is excluded from this discussion.

The clinical symptoms of luetic stricture of the œsophagus are those associated with obstruction in the swallowing act, superimposed upon the systemic infection. Dysphagia is usually the first to be complained of, and is gradual and progressive. Loss of weight follows, due in part to dietetic restrictions and possibly to the effects of the systemic infection. Cachexia and loss of strength are not as pronounced as the weight loss, a condition also noted in organic gastric syphilis. Emesis may be present, depending on the degree of obstruction. Pain is usually absent. The history of an infection may be denied. Men are more often affected than women. The age incidence and the interval between the primary infection and the onset of the obstructive lesion are not known.

The objective findings are the evidences of loss of weight and possibly suspicious lesions elsewhere that suggest lues.

The laboratory findings are of great aid in the diagnosis. Careful serological tests should be made in all cases of œsophageal obstruction and appraised accordingly. All cases of dysphagia should have a careful X-ray examination of the œsophagus and at times the stomach as well. Both fluoroscopic and roentgenographic methods should be used, employing a thick bismuth mixture that will not pass too easily and too rapidly. The opaque medium will readily indicate the presence and the degree of an obstructive lesion at an early date.

The differential diagnosis of luetic stricture must be made from a large number of œsophageal lesions accompanied by dysphagia, from a correlation of the history, the physical examination, the serological tests, and the roentgen examination. Traumatic stricture, foreign body, diverticulum, and cardiospasm are readily differentiated by the X-ray. Carcinoma of the œsophagus presents the clinical picture of a more pronounced cachexia, is of more rapid progress, is usually located in the middle third or at the cardia. The X-ray

Fig. 1. Stricture of the œsophagus with dilatation proximal to the site of the obstruction.

findings of obstruction with dilatation above the site of the lesion are common to both types of disease (Fig. 1). In carcinoma though, the filling defect may be more abrupt, irregular, and moth-eaten, and the canalization may be more eccentric and tortuous. A history of luetic infection, the presence of other tertiary lesions, and the Wassermann test will aid in the differential diagnosis. Then, too, the therapeutic test of appreciable improvement under thorough specific treatment will usually confirm the diagnosis. Finally, the X-ray filling defect and the obstruction are not appreciably effaced by instrumental dilatations in cancer. Pedunculated polypi, angioma, and other benign neoplasms must be thought of and excluded by œsophagoscopy in doubtful cases. The other infectious granulomata can be excluded by a careful history, negative Wassermann tests, and absence of evidences of these infections elsewhere. Extensive intrathoracic pressure on the œsophagus is usually not associated with a similar degree of dysphagia and obstruction, if dysphagia is present at all. Many cases with a large mediastinal tumors have been recorded which have shown no difficulty in swallowing. In this latter group of cases the pressure symptoms are referable more to the respiratory and to the circulatory systems. Physical examination and X-ray examination will show the presence of a marked increase in the mediastinal dullness and density. Dysphagia has been noted in certain cases of Pott's disease with abscess formation, and also in certain diseases of the central nervous system, but here the exciting or underlying causes can easily be detected. Segmental muscle spasm (exclusive of cardiospasm) may possibly occur from abrasions or simple ulcerations, or nervousness, but cannot be demonstrated if they ever do occur as a cause of dysphagia. Such spasm has been seen as a reflex of an early carcinoma (2).

The treatment of syphilitic stricture of the œsophagus is two-fold. A well-balanced diet to maintain nutrition and thorough and competent antiluetic therapy is imperative, preferably by a specialist. Instrumental dilatation with a set of graduated metal dilators passed on a string guide with a flexible staff should be carried out frequently and regularly as needed to enlarge the lumen and keep it dilated. This can be done without an anæsthetic, caution being used to dilate gradually and slowly and without too much force on account of the possible danger of traumatic perforation or hæmorrhage. The progress in the treatment of obstruction can be followed in fluoroscopic examinations. Gastrostomy should be done in obstinate cases not yielding to the more conservative treatment.

The prognosis will depend upon many factors but should be good if the infection can be controlled and the obstruction relieved. It is reported to be bad in the presence of extensive fibrosis of long standing.

A white, obese, male patient, age 63, was referred for examination on June 1, 1922, with a diagnosis of obstruction of the œsophagus. Previous history was entirely negative except that he had been married 21 years without his wife being pregnant, and that venereal infection had been denied at first but later admitted as having had a painless extragenital chancre 26 years ago of 6 weeks' duration, and had been treated medically for 18 months thereafter. His chief complaints were progressive dysphagia and loss of weight since October, 1921. He had a sticking sensation in swallowing in mid-œsophagus but no pain. In April and May, 1922, he had ten dilatations elsewhere for obstruction supposed to be malignant. He has been dieting more or less since the onset.

Physical examination showed a man weighing 208 pounds, with evidences of weight loss, with liver uniformly enlarged measuring 6 centimeters below costal margin in the right mammary line, with spleen palpable on deep inspiration. Balance negative.

The laboratory findings were as follows: urinalysis, negative; blood Wassermann tests, four plus and three plus respectively; negative X-ray of œsophagus and stomach for obstruction. (Patient had been dilated.)

Summary and conclusions: visceral lues; dysphagia; no evidence of malignancy. Refer for antiluetic treatment. Re-ray œsophagus in 6 to 12 weeks if necessary.

Follow-up record: The patient was given thorough specific treatment elsewhere with improvement after salvarsan and potassium iodide, but more recently on mercury injections over a period of time his dysphagia recurred, and with it a loss of weight. Examination on November 20, 1922, showed his weight to be only 191 pounds and some muscular weakness. X-ray examination revealed a moderate obstruction in the middle third of the œsophagus slightly above the level of the nipples, with 50 per cent reduction in the diameter of its lumen. The stricture was smooth and concentric. Marked dilatation above the site of stricture.

Diagnosis: stricture of œsophagus, middle third, luetic.

Treatment. November 24, 1922, dilatation of stricture of œsophagus with Nos. 35, 37, 39, 41, 43 and 45 (F) metal dilators; no bleeding; stricture localized and yields with some difficulty, especially with the last two dilators; no anæsthesia.

December 4, 1922, dilated with Nos. 35, 37 and 39 (F).

December 5, 1922, dilated with Nos. 39, 41 and 43.

December 6, 1922, dilated with Nos. 43 and 45.

December 9, 1922, re-rayed and showed slight retardation at site of old stricture—lumen smooth and greatly enlarged. Dilated with Nos. 41, 43 and 45, without difficulty.

December 16, 1922, dilated with Nos. 43 and 45, no obstruction.

December 30, 1922, dilated with No. 45, no obstruction, no dysphagia.

January 14, 1923, dilated with Nos. 43 and 45, no obstruction, eats freely of all foods, no dysphagia.

January 28, 1923, dilated with No. 45, no obstruction, no dysphagia.

February 10, 1923, dilated with No. 45, no obstruction, no dysphagia. Further dilatations are to be given as needed, and in addition he is receiving careful specific therapy.

SUMMARY

1. Stricture of the œsophagus is a rare complication of visceral syphilis.

2. It may simulate carcinoma of the œsophagus or other obstructive lesions.

3. The clinical history,—positive serological tests, X-ray findings, and signs and evidences of syphilis elsewhere—will aid in the differential diagnosis.

4. Thorough antisyphilitic treatment is imperative.

5. The obstructive features of the disease are surgical and respond to instrumental dilatations. These dilatations must be repeated at varying intervals over a long period of time.

6. Gastrostomy should be performed in obstinate or advanced cases, if necessary, to maintain nutrition, if the more conservative methods fail promptly to relieve the obstruction.

7. The possibility of a malignancy being superimposed upon a syphilitic ulceration must be considered.

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GASTRO–ENTEROSTOMY[1]

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THOSE of us who graduated in the early eighties will remember that Nicolandini first suggested gastro-enterostomy for pyloric obstruction, and his suggestion was acted upon by Woelfer, September 28, 1881, when operating upon a patient with a cancer of the pylorus too large to be excised, he performed a gastro-enterostomy by the anterior method; the patient's condition was improved by the operation. The anterior operation, however, fell into disrepute because in it the jejunum is drawn over the transverse colon and may possibly constrict it and lead to obstruction, and also because with the long loop there is apt to be a drag on the gut producing a spur or kink resulting in the establishment of a vicious circle.

When radical operation (sub-total gastrectomy) is out of the question anterior gastro-enterostomy is now very seldom done; in fact, the only reason for attempting it is when, because of existing pathology, the posterior method is impossible.

The chief objection to anterior gastro-enterostomy as usually performed is the presence of a long loop of jejunum. It not infrequently happens that the proximal half of the long loop, owing to its inability to drive its contents onward, becomes water-logged, resulting in the vomiting of bile, a variety of vicious circle, or in one or another type of postoperative vomiting, such as:

1. Regurgitation of duodenal contents through the pylorus;
2. Escape of fluid from the stomach into the afferent loop;
3. Escape of fluid from the afferent loop into the stomach; and
4. Regurgitation of the contents of the efferent loop into the stomach.

The third of these conditions is believed to be the most common as well as the most serious. I have always thought it best when making an anterior gastro-enterostomy also to make an entero-enterostomy (jejuno-jejunostomy) at the most dependent point of the afferent or proximal loop.

It was left to von Hacker to suggest the anastomosis by the posterior method.

Gastro-enterostomy for ulcer was first performed by Doyen in 1893, after both he and Talma had independently come to the same conclusion, namely, that spasm of the pylorus was the chief factor in maintaining hyperchlorhydria and that this prevented the healing of a gastric ulcer. It will probably be remembered that Rydygier performed the first operation for the cure of gastric ulcer in 1881, when he resected a large ulcer on the posterior wall of the stomach. Since those early days the names of Paterson, Mayo Robson, Moynihan, Key, the Mayos, Finney, and more recently Judd, Balfour, Wilensky, and others too numerous to mention, have been associated with the development of surgery in relation to ulcer of the stomach and duodenum.

We must not forget the work of Beaumont, of Pavlow, of Bayliss and Starling, of Cannon and of Carlson, in regard to gastric digestion; nor that of Gaskill, Langdone Brown and Alvarez on the nervous control of the stomach and duodenum. Too often in the past, before these contributions to the subject, gastric surgery had been worse than a failure, not so much with regard to the anatomy as with reference to the actual pathology and physiology of the digestive organs.

An interesting point brought out by Carlson, in his most recent work on the physiology of the alimentary canal, shows that ulcer pain is present even without gastric acidity, and furthermore that the pain can be controlled (in the presence of gastric acidity), not only by the administration of alkalies, but by actually putting acid into the stomach. In fact "anything and everything we put into the stomach (warm or cold water, acids, alkalies, food, mechanical stimulation) temporarily inhibits the stomach tonus and contractions." It is this inhibition of contractions, therefore,

[1] Read before the Medical Society of the County of New York, February 26, 1923.

which control the ulcer pain. If this contention can be upheld it should have a far-reaching effect on the medical as well as the surgical treatment of peptic ulcer.

Although my subject is the use of gastro-enterostomy in the treatment of peptic ulcer, I want also to say a word about the abuse of the operation, its indiscriminate use when an ulcer cannot be demonstrated, as well as some of the other of its indications besides chronic ulcer. Gastro-enterostomy inadvisedly performed in the absence of a lesion, intrinsic to the stomach or the duodenum, may result in very positive derangement of the digestive function which did not exist before.

Gastro-enterostomy for ulcer is both a physiological and an anatomical operation. In gastric or duodenal ulcer, there is a lack of balance between the gastric acids and the duodenal alkalies which results in spasm of the pyloric sphincter. In gastro-enterostomy we have an operation whereby the patient makes use of his own alkalies for neutralization of the increased acid secretion, while at the same time the new opening provides an outlet for the food taken into the stomach. Gastro-enterostomy acts mechanically and in no other way, declares Moynihan.

The motor and secretory functions of the stomach show marked changes following the operation for gastro-enterostomy. The physical alkalinization occurs as may be shown by the constant presence of bile in the gastric contents after the existence of the new stoma.

Paterson has shown that the total gastric acidity is lowered about thirty points after gastro-enterostomy, his work having been based on a series of cases in which only gastro-enterostomy was done. Guy, in studying the effect of gastro-enterostomy on gastric function, declares the motor and secretory functions of the stomach are profoundly modified by the existence of the new stoma, which permits a readier exit for the food and a freer entrance for the duodenal contents. The fractional test meal shows that bile is constantly present in the stomach after gastro-enterostomy. Since bile is present, it must be assumed that the pancreatic juice has an equally free means of entrance although it cannot be detected by any simple chemical test.

Notwithstanding the fact that in some cases of gastro-enterostomy the stoma is apparently functionless as regards foods, bile is found in every specimen of gastric contents examined. There is some difference of opinion as to whether the emptying time of the stomach is increased or decreased following gastro-enterostomy, but I feel that after gastro-enterostomy, properly performed, for a justifiable indication, the stomach will be found to empty more rapidly than normally.

Among the surgeons who operate comparatively frequently for gastric ulcer, there is still a diversity of opinion as to whether a gastro-enterostomy alone should be done, whether it should be accompanied by excision or artificial perforation of the ulcer by cautery and closure, or a pylorectomy, or a subtotal gastrectomy be made. With the exception of very small ulcers which can be excised and the closure made without in any way altering the normal motor function, I think excision of the ulcer plus a gastro-enterostomy is the accepted procedure for the majority of surgeons, especially when that portion of the digestive tract in which the ulcer is located is freely deliverable. Irrespective of whether or not a true peptic ulcer ever undergoes carcinomatous degeneration, it is better to remove the ulcer with the surrounding indurated wall, since an early carcinomatous ulcer is indistinguishable from a chronic callous ulcer. Wilensky and Thalheimer have pointed out that of 748 ulcerated gastric lesions studied by them, all of which appeared benign grossly, 18.7 per cent were proved by the microscope to be malignant. In the laboratory of the Lankenau Hospital, under the directorship of Dr. Stanley P. Reimann, carcinoma engrafted upon gastric ulcer has been found in 30 to 35 per cent of cases. Since ulcer of the duodenum very rarely develops into cancer, it is not so imperative to destroy or remove this lesion, although perforation and hæmorrhage must be kept in mind as possible complications, the former occurring in a comparatively high percentage of cases. It is known that a peptic ulcer may perforate even after gastro-enterostomy alone has been performed, and I feel sure that a definite percentage of the marginal ulcers which occur following gastro-enteros-

tomy are due to a lack of thoroughness in dealing with the initial lesion which remains as a focus of infection.

It is my practice to excise or destroy by cautery the small duodenal ulcer and make a gastro-enterostomy. In the large ulcer of the first portion of the duodenum, where the wall of the bowel is infiltrated wide of the ulcer, I make a pylorectomy, including in the section the pylorus and the duodenum to below the point of infiltration, and follow with a posterior gastro-enterostomy.

Gastro-enterostomy alone is indicated in cicatricial obstruction of the pylorus and in extensive, benign ulcerative disease of the pyloric end of the stomach, where the condition of the patient will not warrant a more extensive operation. Subtotal gastrectomy should be considered later, yet we must not lose sight of the fact that absorption and dissipation of the mass have been known to take place in not a few cases. I have been able to prove this in patients upon whom I have made a gastro-enterostomy and later had occasion to open the abdomen for other conditions. Taking advantage of this opportunity to examine the site of the former pyloric mass, I have found it absent and the stomach grossly restored to normal. Doubtless many other surgeons have had a similar experience.

Gastro-enterostomy alone is indicated in large ulcers involving much of the lesser curvature or of the posterior wall of the stomach, with adhesions to the liver or the pancreas, which forbid excision or subtotal gastrectomy. In ulcer of the cardiac end of the stomach, not amenable to excision or destruction by cautery, gastro-enterostomy is occasionally performed. While I believe operation offers something in this class of cases, the results are not nearly so satisfactory as in the aforementioned conditions.

Gastro-enterostomy alone, I would also say, is indicated in gastric or duodenal ulcer with recurrent hæmorrhage which forbids removal of the ulcer. This, with blood transfusion, will tide the patient over the critical period and make removal of the ulcer at a subsequent time a safer procedure. Cases of this kind are, in my experience, rare, still I have seen an occasional one.

In obstruction of the pylorus or the duodenum, due to adhesions to the liver, as sometimes occurs after removal of the gall bladder or after operation upon the common bile duct, gastro-enterostomy will provide a functioning stoma resulting in relief of symptoms; in hour-glass stomach where the constriction is close to the pylorus and the pyloric pouch is small, the new opening, of course, should be made in the cardiac pouch, close to the site of the constriction. There are instances on record where two gastro-enterostomies have been made in hour-glass stomach, one in each pouch, but I have never done it.

Gastro-enterostomy is rarely necessary in the operation for saddle-back ulcer of the lesser curvature causing hour-glass constriction as circular resection suffices in practically all cases; but it may occasionally be best to make a gastro-enterostomy after the circular resection.

Where the induration of the walls of the stomach is widespread, a subtotal gastrectomy will be the better operation. In case of bleeding stomach, caused by toxic erosions (Dieulafoy's ulcer) gastro-enterostomy has been done. Personally I have used it in only one instance, with a negative result.

In extreme chronic gastric dilatation, in the absence of a patulous pylorus, where there is retention, and the stomach never completely empties itself, gastro-enterostomy has given me satisfactory results.

In a very limited number of cases of leather-bottle stomach (linitis), I have had success with the operation of gastro-enterostomy alone. This is an exceptional experience, I grant, since in the great majority of cases this condition is inoperable. My first experience with the operation for this condition was reported some years ago. The patient was a doctor and a personal friend. The stomach was diffusely infiltrated and greatly reduced in size, with practically complete obstruction of the pylorus. When the stomach was exposed and palpated, I first thought that nothing but complete removal offered, but upon more careful study I concluded I could make an anterior gastro-enterostomy, which I did. The patient lived 15 months in comfort, finally dying of carcinoma. My experience with these "leather

bottle" stomachs is that they are all carcinomatous. I have seen a number of these cases and in nearly all I have been unable to do anything. This leads me to say that gastro-enterostomy alone in carcinoma is not by any means a very satisfactory procedure, yet sometimes it does prolong life a short time. When operation is feasible, the general condition of the patient allowing, I very much prefer subtotal gastrectomy, making the Balfour operation, bringing the jejunum over the transverse colon rather than through an opening in the transverse mesocolon; or a Moynihan, short loop anterior gastro-enterostomy. The mortality in my experience has been less after the radical operation than after gastro-enterostomy alone; the postoperative life is longer and the morbidity less.

For some time it has been taught that a perforated ulcer is a cured ulcer, and as a result of this teaching it has become the accepted practice merely to close the perforation. I believe that this practice carries with it definite potential dangers, since we now know that perforation does not always cure the ulcer and, secondly, we cannot be sure that a latent carcinoma is not present in the margins of the ulcer crater. It is for the latter reason particularly that I prefer excision of any ulcer to perforation by the cautery. I am a confirmed advocate of gastro-enterostomy as a part of the treatment for perforated ulcers where the patient's condition permits. I do not agree with those surgeons who say that it is unwise to do a gastro-enterostomy for a condition that is going to be cured anyhow, since I have had to re-operate on too many patients that were treated by the simpler method.

The best results from gastro-enterostomy are to be expected, first, in that group of cases where the stoma furnishes a new outlet, necessitated by cicatricial pyloric stenosis, and, secondly, in those cases where intense pylorospasm so upsets Meltzer's law of contrary innervation as symptomatically to simulate the first condition. In these cases relief by gastro-enterostomy is in direct ratio to the extent and duration of the pathological physiology.

We do have failures following excision of the ulcer or excision plus gastro-enterostomy. Some of these failures may be due to neglect in removing a diseased gall bladder or appendix at the time of the operation. I do not believe that any operation for peptic ulcer will give uniformly satisfactory results unless primary foci of infection are sought for and removed. This fact is too frequently forgotten by many surgeons. Or a stoma wrongly placed, an obstruction of one of the jejunal limbs, a kink or a spur, or too small a stoma, all of which are errors in technique, may be the cause of persistence or aggravation of symptoms. Recrudescence of the symptoms may also be attributed to the development of a new ulcer in the stomach or duodenum or of a marginal ulcer, or the reactivation of a healed or partially healed ulcer.

I have said nothing about gastro-enterostomy in infantile pyloric stenosis, as this operation has been replaced by Rammstedt's method. I may remark, however, that where the duodenum has been accidentally opened in making the Rammstedt, as has been known to occur, gastro-enterostomy may be required.

I have purposely not discussed operation in acute or subacute peptic ulcer. I am fully in accord with my medical friends, that the acute and the subacute peptic ulcers belong to them, but when they become chronic, which I believe the most of them do, they are then surgical and to treat them medically is to court disaster.

A word as to medical treatment of ulcer. For the reasons which I have given you for my belief in excision of the ulcer, it must be evident to you that I do not entirely agree with Dr. Sippy and Dr. Einhorn that it is safe to temporize with chronic gastric or duodenal ulcer. The complications of hæmorrhage, perforation, and malignant degeneration are too frequent and too serious to allow procrastination in radical treatment. There are numerous reasons why medical treatment does not permanently cure ulcers. That the methods in vogue relieve the symptoms for the time being there is little doubt. But even taking it for granted that there is definite clinical and X-ray evidence of the existence of the ulcer, there is no other means than by opening up the abdomen, of demonstrating the underlying focus or foci of infection or of possibly associated infections. It is a well-known fact that in a very large per-

centage of cases the appendix is found definitely diseased and with a strong suspicion as to the origin of the infection in the stomach or the duodenum which led to the development of ulcer. In a small, but still very appreciable, number of instances the gall bladder is likewise involved. It is in these cases that surgery offers the better chance for a cure, inasmuch as these organs can be dealt with at the same time as the actual ulcerous lesion. If the internist believes in treating oral or throat and nose sepsis as possible foci of abdominal infections, he must also recognize the logic of removing intra-abdominal sources of infection.

Medical treatment of chronic ulcer fails also because the chronic induration prevents the approximation of the mucosa, and at the most it allows healing only by the formation of cicatricial tissue which is less resistant, and therefore more easily attacked by the acid gastric secretion. It may fail also because it is based on the assumption that the patient, whatever his economic status, will co-operate in the prolonged and elaborate dietary regimen necessary to correct the condition as far as possible. Einhorn claims good results in feeding through the retained duodenal bucket, the rationale being rest of the ulcer. I cannot help repeating what I have so often said that it is after operation that the medical treatment of ulcer is in place. The co-operation of the internist with the surgeon is necessary following operation; for too frequently a good surgical result has been forfeited because of dietetic indiscretions of the neglected patient. Bastedo is correct when he says we must no longer tolerate the surgeon who places an ulcer patient on a bulky or heavy diet shortly after operation. The modern surgeon will look for improvement in his results not so much to refinement in surgical technique as to increased postoperative co-operation from the internist.

SURGICAL SIGNIFICANCE OF MESENTERIC LYMPHADENITIS[1]

By LEONARD FREEMAN, M.D., F.A.C.S., Denver, Colorado

THE object of this paper is not the discussion of the ordinary and rather rare "tabes mesentericus," in which the intestinal mesentery is occupied by large. definitely tuberculous lymph nodes, often caseated or calcified. On the contrary, the intention is to consider a form of lymphadenitis characterized by the presence of numerous small, soft nodes, which, although common, is not as frequently recognized by surgeons as its importance demands. In fact, I have been unable to find any reference to it in most American textbooks on surgery or current surgical literature. The only article I have seen that deals comprehensively with the subject from a surgical standpoint is by J. W. Struthers.[2]

PATHOLOGY

The essential feature is a multiple enlargement of the lymph nodes in the mesentery of the small intestine, especially of the lower ileum. Involvement of the nodes in connection with the cæcum and ascending colon is much less frequent. They seldom are much larger than a large pea, are quite uniformly soft, and without external evidence of acute inflammation. The peritoneal covering remains smooth and uninvolved, although the mesentery itself may be thickened. There often is considerable clear fluid in the abdomen, sometimes enough to fill the small pelvis.

These enlarged nodes can be felt as smooth nodules and seen as small reddish areas scattered profusely through the mesentery. They usually are present in greater number toward the root of the mesentery.

The source of infection manifestly is within the intestine, but there usually is no reason to suppose that ulceration exists, tuberculous or otherwise. I am inclined to believe. with Struthers, that the infective agent gains entrance to the nodes by absorption from the normal, possibly "catarrhal" mucosa, perhaps following the ingestion of contaminated milk or other food.

Frequently I have removed nodes for laboratory investigation. Some of them revealed a simple hyperplasia and others exhibited evidences of tuberculosis. In a number of instances guinea pigs were inoculated, some of which developed tuberculosis while in others the result was negative.[3] I am inclined to believe, however, that if a sufficient number of glands had been tested, a large majority would have been found to be tuberculous. In fact, the situation, perhaps, is similar to that which exists in lymphadenitis of other regions, for instance the neck, where some of the nodes are frankly tuberculous and others merely enlarged "in sympathy"—possibly from the irritation of toxins.

It is probable that the disease represents the first stage of an ordinary tabes mesentericus, and in fact I occasionally have seen a few caseous and calcified nodes among a host of small, soft ones. But, because of the rarity of fully-developed tabes and the frequency of the form under discussion, we must assume that the disease is usually self-limited and seldom develops into the more rare. but better known type. Nevertheless. it should not be lost sight of that the two affections may be entirely separate entities, occasionally associated with each other.

It has not been demonstrated, as far as I know, that the tuberculous infection is of the bovine type; but I suspect that this is true, and that the bacilli are derived from milk or other contaminated foods.

The disease is found mainly in children of both sexes, although seen occasionally in young adults. Statistics, derived from the postmortem records of large institutions, seem to show that it is much more frequent in some localities than in others. It may be associated with rickets.

[2] Edinburgh M.J., 1921, xxvii, 22.

[3] This pathological work was skilfully carried out by Dr. Helen Craig, in the laboratory of St. Joseph's Hospital, Denver.

[1] Read at a meeting of the Western Surgical Association, Minneapolis, December, 1922.

In none of my cases have I detected tuberculosis elsewhere in the body, and Struthers reports a similar experience; but I can see no reason why this should universally be true.

SYMPTOMS[1]

Frequently these are so characteristic that it seems as if a pre-operative diagnosis should easily be made; but I have seldom been able to do this, because, perhaps, of a tendency to think of appendicitis before considering anything else.

There is *abdominal pain*, usually somewhat diffuse, but with a predilection for the right lower quadrant, due, perhaps, to the fact that the attachment of the affected mesentery runs obliquely in that direction. This attachment to the posterior abdominal wall may also have to do with the frequency with which the pain seems to run through into the back. It usually is not severe and often quite difficult to locate with exactness.

Distinct *abdominal colics* frequently occur, which come and go quickly, without apparent cause. These probably are produced by spasm of the bowel—a spastic ileus, as it were. During operations I frequently have observed the ileum go into violent spastic contraction at a mere touch.

The explanation of this probably has to do with irritability of the mesenteric nerves, produced by the enlarged lymph nodes and other mesenteric abnormalities. In fact, my observations have impressed me with the idea of an unusually "irritable abdomen," manifested particularly in the intestines, the pylorus, and the muscles of the abdominal wall.

These colics, I believe, may be regarded as a valuable diagnostic symptom, and when they are present they should lead one to suspect mesenteric lymphadenitis.

It is interesting to speculate, in this connection, how much mesenteric lymphadenitis may have to do with intussusception; for, as is well known, this almost always is preceded by local spastic contractions.

Abdominal tenderness is always present, but it is more diffuse and not so pronounced as is usual in appendicitis. Its general location is toward the right lower quadrant, for the same reason that this is the principal seat of pain.

Abdominal rigidity is not a prominent feature unless there is a coincident appendicitis. Like pain and tenderness it is more or less diffuse, but with a tendency toward the right side.

A moderate elevation of temperature is often observed. It seldom goes higher than 99° to 100°, and is not accompanied by chills. It may persist for weeks or months.

Loss of energy and flesh are quite constant and occasionally there are severe, prolonged headaches, perhaps due to some form of toxæmia. In one patient, a girl 17, a toxic blindness developed in one eye.

Various gastro-intestinal disturbances are common, such as loss of appetite, nausea, pyloric spasm, flatulence, constipation, and occasionally diarrhœa.

COURSE AND DIAGNOSIS

In some instances the course of the disease is acute, as in most of Struthers' cases, while at other times it is more or less chronic, as in the great majority of my own observations.

The similarity of symptoms is such that a differentiation from appendicitis is difficult and, with our present knowledge, often impossible. But even when the diagnosis is highly probable, one would hardly be justified in withholding an operation for fear of making a regrettable mistake.

Looking at the question broadly, when one encounters a child with indefinite abdominal pain, tenderness and rigidity, manifesting themselves mostly in the right lower quadrant, with digestive symptoms, loss of energy, and perhaps a moderate rise in temperature, one should suspect a possible mesenteric lymphadenitis, especially if the symptoms persist for several weeks or months and are accompanied by frequent intestinal colics.

Since there is an apparent lack of knowledge of the significance of the disease, or even of its existence, it undoubtedly is often overlooked, in spite of its frequent occurrence, thus adding one more to the multitude of troubles in the right abdomen which so often mystify

[1] Dr. J. N. Hall has helped me much in the elucidation of both symptoms and diagnosis.

and baffle the surgeon. There is room for abundant speculation regarding the possible inter-relationship of chronic appendicitis, mesenteric lymphadenitis, movable cæcum, and the various bands, membranes and kinks infesting this part of the abdominal cavity.

TREATMENT

Primarily this must be surgical, because of the ever-present suspicion of appendicitis; but fortunately, according to my own experience and that of Struthers, recovery, at least symptomatic, usually follows a laparotomy, much as it does in tuberculous peritonitis.

When the diagnosis is once assured by opening the abdomen, appropriate medical and hygienic measures undoubtedly are in place and may be of much benefit.

One of my cases furnishes a typical example of the effects of abdominal section followed by medical supervision:

A boy, age 12, had been sick for a year with abdominal symptoms as previously described, combined with headaches, slight fever, and loss of energy, so that he was unfitted for either play or study. At one time he had been treated for "walking typhoid." An operation revealed marked mesenteric lymphadenitis, with considerable fluid in the peritoneal cavity. The appendix was practically negative, and there were no intestinal "kinks" or adhesions. A lymph node subjected to the guinea pig test was shown to be tuberculous. Following the laparotomy the symptoms rapidly disappeared, so that the boy returned to school and resumed his normal activities. Over a year later he was still in excellent condition.

SUMMARY

1. Mesenteric lymphadenitis is a common disease of children and young adults, which has received too little attention from surgeons.

2. It is characterized by enlargement of numerous lymph nodes, usually small and soft; the infecting agent being, in many instances, the tubercle bacillus, presumably of the bovine type.

3. The most prominent symptoms are: moderate pain, tenderness and rigidity, mostly in the right lower quadrant of the abdomen, often associated with slight fever, headaches, occasional colics, various gastro-intestinal symptoms, and loss of weight and energy.

4. The disease is nearly always confused with appendicitis.

5. Because surgeons are unfamiliar with the trouble, it is seldom recognized during operations.

6. It has a strong tendency toward recovery, at least symptomatically following laparotomy.

AN EXPERIMENTAL ANATOMICAL INVESTIGATION OF THE BLOOD AND BILE CHANNELS OF THE LIVER

With Special Reference to the Compensatory Arterial Circulation of the Liver in its Relation to Surgical Ligation of the Hepatic Artery—Report of a Case of Arteriosclerotic Aneurism of the Gastroduodenal Artery[1]

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IN 1916 Dr. Louis Gross working in these laboratories elaborated an efficient and simple technique for the reconstruction of the vascular system of organs with which he obtained excellent results, especially in his work on renal and cardiac circulations. He also prepared in this manner instructive preparations of lungs, placentæ, and livers. By thus shedding new light upon the distribution of blood vessels within organs, Gross opened an interesting and important field for further investigation into the physiological and pathological architecture of organs and its relation to normal and abnormal function.

This investigation was undertaken in the hope that it might thus be possible to contribute something to an accurate knowledge of the normal and abnormal distribution of the blood and bile channels of the liver.

TECHNIQUE

A complete description of the apparatus and of the technique of injection is given in Gross' monograph on *The Blood Supply to the Heart.* Briefly it consists of injecting an emulsion of barium sulphate in gelatine (in an injection cabinet, provided for this purpose) and making stereoscopic X-ray pictures of the injected vascular tree. Blood vessels are previously washed out thoroughly with physiological saline heated to 37° C. The apparatus provides control over standard conditions of temperature and pressure so that a series of organs may be injected under uniform conditions. Evidence obtained from stereoscopic views is correlated with that derived from gross dissection and microscopic serial sections. Dissection is greatly facilitated by previously clearing the organ, using a modified Spalteholz method.

In removing the liver from a human subject at autopsy for the purpose of injecting one or other of its systems of channels, it is desirable to include in the specimen, the entire diaphragm, the ostium of the inferior vena cava into the right auricle, the upper third of the abdominal aorta, and at least 1 inch of the common bile duct and of the portal vein. It is advisable to proceed with the injection within 36 hours after death, i.e., before the vessels become autolyzed. When either the hepatic artery or portal vein is to be injected, both these vessels are washed out with physiological saline heated to 37° C. For an adult liver about 5 to 8 gallons of saline, injected continuously at a pressure of 200 millimeters of mercury, are required completely to rid the vessels of blood clots. The washings flow out through the hepatic veins. Occasional light kneading of the liver helps to break up postmortem clots. When, even with the kneading, the washings from the hepatic veins are no longer blood-stained, it may be assumed that the vessels are cleared of blood. The warm saline also causes relaxation of the musculature in walls of the smaller vessels. During the saline injection, the gall bladder gradually becomes distended and when the limit of expansion of its walls is reached, thin, bile-stained saline very slowly flows from the common duct. The accumulation of fluid in the gall bladder is no doubt due, first, to the permeability of the hepatic cells for the saline, and, second, to the permeability of the mucous membranes of the bile ducts and of the gall bladder, which receive arterial blood through branches of the hepatic artery and drain their venous blood into the portal vein.

If it is proposed to inject the hepatic veins then a large cannula, 1.0 to 1.5 centimeters in diameter, is tied into the inferior vena cava

[1] With the aid of a grant from the Cooper Fund.

at its entrance into the right auricle while the vein is ligated inferiorly just below its attachment to the inferior surface of the right lobe of the liver. Through this cannula saline is injected until the washings draining out of the portal vein and hepatic artery are clear. The gall bladder receives relatively less fluid than during injection of saline through hepatic artery or portal vein. This is explained by the fact that little or no saline enters the ducts or the gall bladder through their own walls, since the former have no radicals of the hepatic vein while the latter has only very few. Practically all the venous blood of the gall bladder and bile ducts is drained away by the vena portæ.

When the liver is completely emptied of blood and only saline circulates in its blood channels, it is of a pale grayish yellow color. De Graaf, working in 1668, injected various colored fluids, such as milk, green fluids, etc., into vessels of the liver and concluded that the color of the gland is due to the contents of the vessels. The very pale color of the liver when its vessels contain only saline, readily explains de Graaf's results.

Because of the fact that the bile-duct system ends blindly in the hepatic cells, it is not possible to wash it out. Unsuccessful attempts were made at aspirating the contents of the bile-duct system. Even with a very slow aspiration current, the vessels collapse wherever a partial vacuum is produced and thus the purpose of the procedure is defeated. The most successful injections were obtained by using livers from cachectic individuals; the bile-duct systems in these cases contain a very small amount of bile, so that a minimum of obstruction is offered to the flow of the barium emulsion.

The barium sulphate emulsion is of such a viscosity at 37° C. that it will flow into the finest precapillary vessels, but will not enter the capillaries themselves. The pressure used for injecting the emulsion into the hepatic artery is determined by the average systolic blood pressure of the individual before death; this, of course, varies for different ages and in different diseases. In order to obtain a complete injection of either of the two venous systems or of the bile ducts, the pressure is manipulated in the following manner: beginning with a pressure of 250 millimeters of mercury, this is gradually diminished to 200 which is maintained until no more air under pressure from the pressure tank is required to keep the manometer reading at 200. This indicates that the system of channels is completely injected; the emulsion has everywhere reached the smallest vessels that it will enter. Then the pressure is very gradually allowed to diminish between 20 and 30 millimeters of mercury—about the normal blood pressure in the veins—the inflow of emulsion is arrested, and the organ immersed in ice cold 10 per cent formalin. In this way undue distention of the vessels is avoided.

THE ARTERIA HEPATICA[1]

The arteria hepatica communis arises as an unpaired trunk from the arteria cœliaca. At a variable point in its course, usually in the middle or last third of the distance between its origin and the porta hepatis (O. T. transverse fissure), it divides into the arteria hepatica propria and the arteria gastroduodenalis. Shortly after its origin, the former gives off the arteria gastrica dextra from its right side. The position of the bifurcation of the arteria hepatica propria into rami dexter and sinister is variable; in the 55 human livers which form the subject of this study the bifurcation occurred in the porta hepatis, near the posterior border of the lobus quadratus in 22, between the porta hepatis and the inferior margin of the lobus quadratus in 19, and at a variable point between this margin and the cœliac axis in the remaining 14 cases. The ramus dexter continued as a single vessel until after its entrance into the liver substance in 41 cases and it divided into a superior and an inferior branch in the porta hepatis in 14 cases. In two of the latter instances, the inferior branch again divided into two vessels, the inferior of which pierced the liver substance somewhat anteriorly to its

[1] For instructive diagrams of the origin and distribution of the arteriæ phrenicæ, arteria cœliaca and arteria mesenterica superior, see references 5, 12, 31, and 39. The diagrams in all these references lack one important detail, namely, they do not show sufficient anastomoses between gastric and duodenal arteries and arterioles. In several injections of the stomach and duodenum made by the author and also in those of fetuses by Dr. Arnold Branch, using the same technique, the arteries and arterioles in the entire gastro-intestinal tract anastomose with each other very freely in all instances. These anastomoses are quite as extensive as those seen beneath Glisson's capsule (see Figs. 5 and 10).

fellow. The ramus sinister remained single during its entire course in the porta hepatis in 42 cases, and bifurcated into a superior and an inferior branch in 13, and in one the inferior branch again divided into two vessels.

Small arteries, 0.2 to 1.0 in diameter, are given off by the propria to the omental tissue of the ligamentum hepatogastricum, and to the walls of the vena portæ and ductus choledochus (O. T. common bile duct). Similar arteries proceed from the rami dexter and sinister to the tissues and structures in the porta hepatis. These small vessels anastomose with each other very freely. In 5 cases the propria, at, or just before, its bifurcation into rami dexter and sinister gave off one or two larger vessels, 1.5 to 3 millimeters in diameter, to the lobus caudatus. Both rami supplied similar sized vessels to the lobus caudatus in all of the 55 livers. The large branch to the lobus quadratus which arises from the ramus sinister in all but 4 cases, also gave, in 26 instances, one or two quite large vessels (1.0 to 2.0 millimeters in diameter) to the lobus caudatus. The arteria cystica which supplies the gall bladder came off from the ramus dexter itself in 46, and from the first inferior branch of this ramus in the remaining 9 cases. In one of the latter instances, the superior branch of the ramus dexter also gave a vessel 2.0 millimeters in diameter to the superior surface of the gall bladder. All these arteries, arising in the porta hepatis, distribute small vessels, 0.3 to 0.5 millimeters in diameter, to the tissues of the porta, in which they anastomose extensively. Through these anastomoses, a bridge is formed between the lumina of the rami dexter and sinister. The ramus sinister itself and its branches to the lobus caudatus supply vessels to the tissues in the fossa for the ductus venosus; these vessels proceed to the postero-superior surface of the liver where they ramify in the region of the inferior vena cava and diaphragm, anastomosing with similar arterial vessels from other sources. The ramus sinister itself and the artery to the lobus quadratus give branches to the ligamentum teres, which form abundant anastomoses with each other.

In order to find and trace anomalies in the origin and distribution of the larger vessels, the entire course of the arteria hepatica communis must be examined. Unfortunately this was not done in all cases, so that the anomalies herein reported do not represent the total for 55 cases. In one case the gastroduodenalis arose on the right side of the bifurcation into the rami dexter and sinister as a large branch 7 millimeters in diameter. In another case the arteria gastrica dextra (see Fig. 4) came off from the propria about 1 centimeter before the latter's bifurcation, while in a third instance this vessel was given off by the ramus dexter, 2 centimeters distal to its origin. (The ramus dexter and ramus sinister have been reported to arise separately from different branches of the tripus halleria—arteria gastrica sinistra, arteria lienialis and arteria hepatica—from the arteria mesenterica superior or its branches, and it is not impossible that the arteria hepatica communis or any of its branches may arise directly from the aorta.) In 11 cases a small (1.0 to 3.0 millimeters in diameter) arteria hepatica accessoria was found coursing anteriorly toward the fossa of the ductus venosus and into the lobus sinister (8) or the lobus caudatus (3). The origin of this artery varied greatly. In 4 cases it came from the arteria cœliaca; in one from the arteria phrenica sinistra inferior, in another from the arteria phrenica dextra inferior, in another from the arteria gastrica sinistra, and in the seventh instance two arteriæ accessoriæ hepaticæ arose from the arteria hepatica communis about 1 centimeter beyond its origin. In the remaining 4 cases it was severed and could not be traced to its origin. Henle refers to a case in which there were three hepatic arteries, one of which arose from the arteria gastrica sinistra, a second from the arteria cœliaca, while the third came from the arteria mesenterica superior. We consider the artery which arose from the arteria gastrica sinistra in our case as an arteria hepatica accessoria, because the propria in this instance was present and bifurcated in a perfectly normal manner. Henle also states that the ramus sinister arteriæ hepaticæ quite frequently arises from the arteria gastrica sinistra.

Twenty-six livers were taken from individuals between the ages of 40 and 80, in all

of whom the aorta showed various degrees of arteriosclerosis. The arteria hepatica showed fatty intimal changes in 12 cases and some calcification occurred in two of these; in the remaining 43 instances, including 14 from individuals between 40 and 80 years old, the arteria hepatica gave no evidence of arteriosclerotic changes.

ARTERIOSCLEROTIC ANEURISM OF ARTERIA GASTRODUODENALIS

While examining the branches of the arteria cœliaca, at the autopsy of a woman aged 76, on exposing the entire length of the arteria gastroduodenalis a small aneurism the size of a pea was found situated 1 centimeter proximal to the mesenteric border of the duodenum (Fig. 1). The external surface of the aneurism was pale yellowish white, and perfectly round and smooth. On palpation its distal wall was found to be very firm. The lumen of the vessel was exposed by cutting it on the side opposite to that from which the aneurism projected. The neck of the aneurism was perfectly round and smooth and measured 3.5 millimeters in diameter. The interior of the sac was lined with a coat of calcareous material which was much thicker on the distal than on the proximal wall.

The cause of death in this case was failure of the right side of the heart due to severe extensive fatty degeneration of the myocardium. The aorta and coronary arteries were markedly arteriosclerotic. The branches of the arteria cœliaca showed only slight fatty intimal changes. There was no history, nor any evidence of syphilis.

DISTRIBUTION OF THE RAMUS DEXTER AND RAMUS SINISTER ARTERIÆ HEPATICÆ PROPRIÆ WITHIN THE LIVER

The hepatic artery was injected in 37 human livers; the distribution of its branches within the liver was studied principally with the aid of the stereoscopic X-ray plates. Several livers were dissected in order to corroborate evidence obtained from the stereoscopic pictures.

The branching of the vessels is strictly dichotomous; the angles formed by branches with their main stems vary from 60° to 90°. The plastic, stereoscopic view of the entire arterial system resembles very closely a spreading tree.

The vessels gradually diminish in size. Considering the ramus dexter or sinister as a branch of the first order, it is found that the injection mass has reached the seventh order of branching—the precapillary arteriole, which is large enough to be visible to the naked eye. The hepatic arterial tree in livers of individuals in the first four decades of life shows little or no tortuosity of its branches and resembles a maple sugar tree as it appears in the fall without its leaves (Figs. 3–7, and 8). In the fifth decade tortuosity is quite evident, but is not very marked (Figs. 4 and 5); in the sixth and seventh decades, it is very prominent so that the entire arterial system resembles a bare old apple tree (Fig. 9). Where tortuosity was present to any appreciable degree it appeared to be somewhat more marked in the left lobe than in the right. This gradual development of a tortuous course with advancing age may be due to a loss of the elasticity of the vessels, or to changes in the fibrous connective-tissue stroma of the liver, or to both these influences.

Either just before or, as occurs more frequently, soon after it enters the substance of the right lobe, the ramus dexter bifurcates into a superior branch and an inferior branch. In our series the former branch is the smaller and the latter is the larger in 89 per cent of cases; in these instances the superior supplies the left posterosuperior fourth of the right lobe, i.e., a portion of the lobus caudatus and the regions posterior and to the right of it. The inferior branch either divides again into two equal sized branches which supply the remaining three-fourths of the lobe, or else it pursues a curved oblique course,—with its convex side directed inferiorly—toward the right superior corner of the lobe, giving off four to six large vessels (third, fourth, and fifth order) at regular intervals of about 2 centimeters apart. The lobus caudatus and the liver substance posterosuperior to it receive branches from the main stem of the ramus dexter both before and after it enters the liver substance, from the superior branch of the ramus dexter and from the first branch of

the inferior; the last vessel distributes itself mainly to liver substance in the region of the gall bladder, i.e., superior and to the right of it. In 7 per cent of the cases the superior is the larger and the inferior the smaller vessel. In these cases the superior gives off a large branch which distributes itself very much in the same manner as the superior branch in the former (89 per cent) series; it then pursues a slightly curved course, with the convex side turned superiorly, giving off large branches which supply the posterosuperior two-thirds or three-fourths of the lobe. The remainder of the lobe receives branches from the smaller inferior branch which, as in the 89 per cent series, sends vessels to the regions around the gall bladder above and to the right of it. In the remaining 4 per cent of cases both branches are of about equal size and supply about equal parts of the lobe. They also distribute vessels to the lobus caudatus and gall-bladder regions similarly to the superior and inferior branches in the 89 per cent and 7 per cent series.

All the large and some of the smaller branches which arise within the liver terminate by a great number of small vessels (sixth and seventh order) near the surface of the liver. Some of these small vessels reach the surface where they divide (not strictly dichotomously) into numerous branches which form an intricate network of anastomoses that is present over the entire surface of the lobe. These anastomosing subcapsular vessels lie in little shallow grooves in the liver surface and are so intimately attached to Glisson's capsule that when this is stripped practically all the vessels accompany it (Fig. 6), leaving a network of fine grooves on the surface of the liver substance. The smaller vessels which terminate within the liver do not participate in the subcapsular anastomoses and are therefore end-arteries. The numerous small arteries and arterioles which are given off by every hepatic arterial branch to the fibrous sheath of the portal canal and to the structures within it anastomose very freely with each other.

The arteria cystica, after a course of 1 to 3 centimeters, first, in the vicinity of the cystic duct and then on the inferior or superior surface of the gall bladder, divides into two main branches, a right and a left. The former was the larger of the two in 70 per cent of cases, the latter in 20 per cent and they were of about equal size in 10 per cent. The main branch was found on the superior surface in 60 per cent of the cases, and on the inferior surface in the remaining 40 per cent. The vessels which come off from the main branch and from its two large branches anastomose very freely together. When the gall bladder is distended, the anastomosing vessels are seen to form a complete system of larger and smaller squares (Fig. 2), giving the appearance of a spider's web, if it were arranged in the shape of a gall bladder. When the gall bladder is collapsed these vessels appear very tortuous (Figs. 4, 5, and 7). On the superior surface of the gall bladder, where it is intimately attached to liver substance, branches of the cystic artery enter the liver and vessels from the first branch of the inferior branch of the ramus dexter, enter the gall-bladder wall, and anastomose with the arteria cystica vessels. From beneath the peritoneum-covered surfaces of the gall bladder, vessels proceed onto the neighboring surfaces of the lobus quadratus and lobus dexter, and anastomose with the other subcapsular vessels in these regions.

The largest artery to the lobus quadratus came off from the ramus sinister or one of its branches in 51 of the 55 livers. In the remaining four cases, the sinistra was found to run anteriorly in the fossa for the ductus venosus and to enter the left lobe in about the middle third of this fossa after giving off only a few small branches to the surrounding connective tissues and to the lobus caudatus. In these instances the ramus dexter alone accompanied the ductus choledochus and the vena portæ in the ligamentum gastrohepaticum, and when it reached the porta hepatis it gave off a large vessel (3 to 5 millimeters in diameter) which ran to the left and entered the lobus quadratus at its posterior margin. In the series of 37 livers in which the hepatic artery was injected, the branch to the lobus quadratus arose from the ramus sinister itself in 48 per cent, from its inferior branch in 50 per cent, and from its superior branch in 2 per cent of instances. In addition to this largest vessel, the quadrate lobe also receives smaller arteries (0.5 to 2

millimeters in diameter) from the ramus sinister and both its main branches and from those of its vessels which go mainly to the lobus caudatus; also from the ramus dexter itself, but more commonly from its branches to the lobus caudatus and to liver substance in the region superior to the gall bladder. The arteria cystica invariably sends branches into the quadrate lobe.

In every case the ramus sinister or its branches send vessels to this lobe in 100 per cent, and its branch to the lobus quadratus in 14 per cent of 55 cases. The superior branch of the ramus sinister gave offsets to the lobus caudatus in 40 per cent and the inferior branch in 48 per cent of 37 instances.

It appears evident that the lobus caudatus and lobus quadratus receive arteries from both the ramus dexter and ramus sinister. Many anatomists consider the lobus caudatus and lobus quadratus as part of the lobus dexter. A careful examination of their vascular supply from the hepatic artery, the portal vein, and bile ducts has made it clear that the lobus caudatus receives the bulk of its vessels from the right main branches and the lobus quadratus from the left (Fig. 2). In 20 per cent of our cases the processus caudatus was fused with the lobus dexter, and in 80 per cent it was completely free. In 79 per cent the lobus quadratus was attached to the lobus sinister by a bridge of tissue which varied from liver substance occupying almost the entire fossa umbilicalis to a thin fibrous cord containing some small vessels which crossed this fossa in the middle third of its length; and in the remaining 21 per cent of cases the fossa was not bridged by any tissue whatsoever. It is a noteworthy fact that in all the eight infants' livers in our series, the processus caudatus was relatively large and fused with the right lobe: the lobus quadratus was also very large and presented liver substance bridging the fossa umbilicalis in no less than the posterior two-thirds of its length. If these two lobes are not to be allowed complete autonomy, that is, if they must belong to either the right or left lobes, then it appears logical from the point of view of blood supply, at least, that the "mandate" for the lobus caudatus should be accorded to the lobus dexter and that for the lobus quadratus to the lobus sinister.

The larger of the two main branches of the ramus sinister usually supplies two-thirds and less frequently three-fourths of the lobus sinister. The superior branch sends more of its vessels posteriorly and the inferior distributes its vessels more extensively in the anterior parts of the lobe. All the larger branches of both superior and inferior, and those smaller vessels which arise from the ramus sinister and its main divisions very near the surface of the liver send vessels to the surface of the liver and there distribute themselves in a similar manner to the subcapsular vessels of the right lobe. The entire liver is thus enveloped by a continuous network of subcapsular anastomosing arteries and arterioles.

It appears evident that the middle portion of the liver, namely, the region including the lobus caudatus and lobus quadratus and liver substance posterior and superior to these lobes receives arteries from both the rami (Fig. 2). Through their subcapsular anastomoses these arteries constitute an important communication between their respective parent vessels.

COLLATERAL CIRCULATION BETWEEN RAMUS DEXTER AND RAMUS SINISTER

It has long been known that obliteration of either the ramus dexter or sinister is not followed by any injury to the portion of liver substance in which the obliterated vessel distributes itself. The probable explanation that blood from the vena portæ sustains the tissues in these cases does not agree with the fact, which is generally accepted from experimental evidence, that, with a normal portal circulation and an obliterated arteria hepatica propria, total necrosis of the liver occurs (Cohnheim and Litten, Haberer, Behrend, et al.). On investigating this question it was found that by preparing the liver for a hepatic artery injection in the usual manner and then ligating either the ramus dexter or sinister, the barium sulphate emulsion being injected only through the unligatured vessel, the entire arterial tree was filled with the emulsion. Knowing that the emulsion is of

such viscosity that it will enter only precapillary vessels, it follows that the anastomoses between the two rami are made up of vessels that are larger than capillaries. These anastomoses have been referred to above; they exist among the subcapsular arteries and arterioles and those that supply the tissues of the porta hepatis and that are derived from the rami dexter and sinister or from their branches. (See Figs. 8 and 9.)

The principal vessels whose terminal branches take part in anastomoses in the vicinity of the middle portion of the liver, are as follows:

From the ramus dexter: (*a*) vessels to the tissues and structures in the porta hepatis; (*b*) vessels to the lobus caudatus given off before and after the ramus dexter enters liver substance; (*c*) the arteria cystica; (*d*) vessels which distribute themselves in the regions superior and to the right of the gall bladder; (*e*) in a small number of instances vessels to the lobus quadratus and to the tissues in the fossa umbilicalis.

From the ramus sinister: (*a*) vessels to tissues and structures in the porta hepatis; (*b*) vessels to tissues in fossa of ductus venosus and fossa umbilicalis; (*c*) the arteries to the lobus quadratus and lobus caudatus.

In addition, the entire surface of the liver is enveloped by a network of anastomosive arteries and arterioles which issue from intrahepatic branches of the rami dexter and sinister arteriæ hepaticæ propriæ.

The more exact nature of the course which the emulsion follows when the entire arterial tree is injected through one or other of the main branches of the propria was determined by the following experiment:

After preparing the liver for an hepatic artery injection, the rami dexter and sinister were severed from the propria and a cannula was inserted into each. The cannula in the ramus sinister was joined by rubber tubing to the Wolff bottle containing the barium sulphate emulsion, while the cannula in the ramus dexter was connected with a short piece of rubber tubing (10 centimeters in length). Using a pressure of 145 millimeters mercury, the emulsion was injected into the ramus sinister; almost immediately after the fluid entered the ramus, the emulsion appeared flowing from the cannula in the ramus dexter. The rubber tubing on the latter cannula was clamped and the injection continued for 3 minutes, i.e., about half the time usually required to inject completely the entire arterial tree. During the course of the injection the cannula in the ramus dexter remained filled with injection mass. As a result of this procedure the subcapsular vessels on the lobus sinister, the lobus quadratus, and those on the left side of the lobus caudatus were well injected, while on the lobus dexter and the right side of the lobus caudatus only a few scattered subcapsular vessels were seen. On examining the roentgenogram of this injection it was found that the ramus sinister and all its branches as far as the seventh order, were completely filled, but that with the exception of the vessels to the mid-portion of the liver and to the gall bladder, the ramus dexter and its branches were completely injected only as far as the fourth and fifth orders and only occasionally in scattered areas were sixth and seventh order vessels filled with emulsion. This experiment was repeated, making the injection through the ramus dexter (see Fig. 10). From these facts we conclude that after the fluid has entered the first and nearest anastomoses it passes along the course of least resistance into their larger parent vessels and then into the main ligated branch (in our experiment the ramus dexter) from which the fluid is pushed onward from behind, so to speak, into the remaining ramifications of the ligated vessel. Since the most proximal anastomoses are in the hilus, the ligated vessel becomes filled with the emulsion almost immediately after the injection is begun, indeed, before any subcapsular vessels appear injected.

These anatomical facts regarding the compensatory arterial circulation between the rami dexter and sinister suggest very strongly that in cases where one of these vessels or their branches are blocked by thrombosis or embolism, etc., the nutrition of the area supplied by the obliterated artery is maintained by a compensatory arterial circulation and not by portal blood. The fact established by experimental evidence that total obliteration of the hepatic artery with co-existing normal

Fig. 1. Arteriosclerotic aneurism of the arteria gastroduodenalis. (A-151-22, fatty degeneration of the heart with dilatation. General arteriosclerosis.) An enlarged photograph of the arteria gastroduodenalis lying upon the inferior surface of the liver. The artery was cut at the point in its course along the mesenteric border of the duodenum just distal to the aneurism which is seen in the photograph as a more brightly illuminated bulging area.

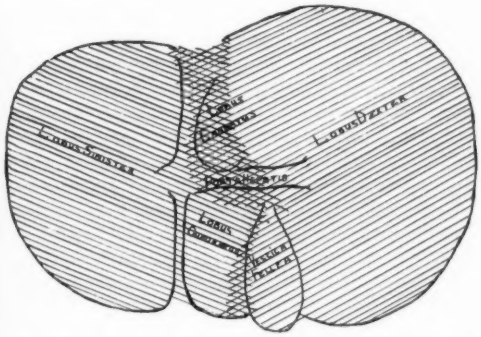

Fig. 2. The checkered areas represent those parts within the liver which are supplied by branches from both the ramus dexter and the ramus sinister of the arteria hepatica propria and vena portæ.

portal circulation was followed by complete necrosis of the liver, must be considered as strong evidence in favor of this view.

It appears, therefore, that oxygenated arterial blood is indispensable to the health and life of liver cells.

ANASTOMOSES BETWEEN HEPATIC AND PHRENIC ARTERIES

The entire diaphragm was not included in every one of the specimens injected through the hepatic artery. However, that portion of diaphragm which covers the bare area of the lobus dexter was present in all of the 37 instances and by gross dissection it was possible to find the arteria phrenica dextra inferior in every case. The phrenic vessels in all 37 instances in which the hepatic artery was injected, were invariably more or less completely filled with emulsion.

The anastomoses which are responsible for the presence of emulsion in the phrenic arteries when the hepatic arteries are injected were found to be present in the layers of peritoneum which are reflected from the liver onto the diaphragm (parts of which form the ligamentum coronarium hepatis and the ligamentum triangulare sinistra): in the areolar tissue between diaphragm and liver surface, and between the layers of reflected peritoneum, including the bare area on the posterosuperior surface of the lobus dexter: in the ligamentum falciforme hepatis: and in and around the walls of the vena cava inferior, —in this latter region larger arterioles from both rami join with terminal vessels of phrenic arteries. These anastomoses are between small arteries and arterioles (sixth and seventh orders of branching) which pass from the liver surface into the layers of peritoneum or the areolar tissue described above and there join with similar vessels which are branches of phrenic arteries. In six of fifteen instances in which the arteria phrenica sinistra inferior was dissected, it gave a large branch which coursed in the ligamentum falciforme hepatis near its attachment to the liver, giving off arteries which anastomosed with similar ones from the intrahepatic branches of the ramus sinister. In all of the 16 cases it also gave smaller branches to this ligament which formed anastomoses with small arteries from the ramus sinister branches.

In the light of the present conception of the developmental anatomy of the liver and diaphragm, it is not at all surprising that the blood supplies of these two structures should be so intimately connected. The liver develops from two endodermal buds of the foregut. At first the endodermal cells arrange themselves to form a simple tubular gland, but as this liver "anlage" becomes partially embedded in the caudal part of the septum transversum, it acquires mesodermal tissue

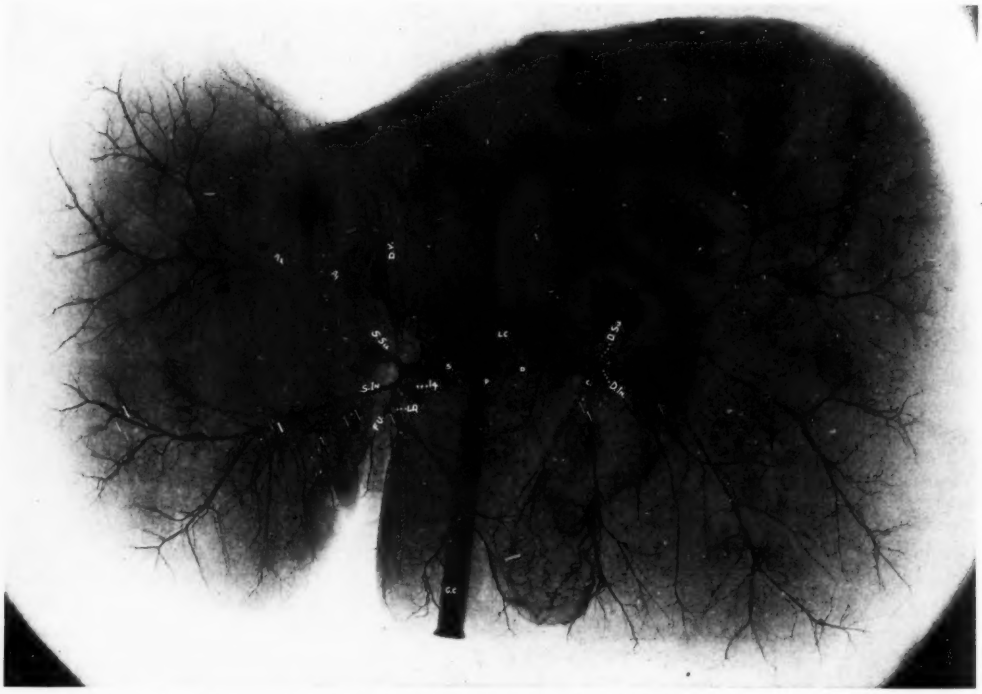

Fig. 3. Arteria hepatica, second decade. (A-158-21.) Roentgenogram of the injected arterial tree in the liver of a male, age 18, who died of generalized peritonitis following perforation of a typhoid ulcer. The glass cannula *g.c.* is in the arteria hepatica propria, *p.*, near its bifurcation into ramus dexter, *d.*, and ramus sinister, *s.* The branches divide dichotomously, gradually diminish in size and they are all quite straight. The branches of the arteria cystica, *c.*, are tortuous because the gall bladder, *g.b.*, is collapsed; note how freely these branches anastomose with each other. *l.c.*, A large branch to lobus caudatus springing from the ramus dexter. *d.su.*, The superior division of the ramus dexter; *d.in.*, the inferior division of the ramus dexter which supplies about three-fourths of the right lobe. *l.q.*, A small branch of the ramus sinister to the lobus quadratus; *L.q.*, the main branch to the lobus quadratus arising from the ramus sinister; *f.u.*, branches of the ramus sinister to tissues of the fossa umbilicus; *d.v.*, branches of the ramus sinister to tissues of the fossa ductus venosus; *s.su.*, superior division of ramus sinister; *s.in.*, inferior division of ramus sinister; a^1, two branches of superior division join to form a single vessel; a^2, a branch of the distal limb of a^1, and a branch of the superior division proper join to form a single artery.

which alters its architecture. Thus by ingrowth of mesodermal tissue which in the adult liver constitutes Glisson's capsule and the stroma of the portal canals, the original simple tubular gland is completely rearranged to form a gland made up of indistinctly separated lobules of secreting cells arranged around the central veins, radicals of the hepatic vein. In addition to supplying the mesodermal tissue of the liver, this caudal portion of the septum transversum also develops into the ligamentum falciforme hepatis and the omentum minus. The intermediate portion of the septum transversum forms the diaphragmatic wall of the pericardium and its cephalic portion develops into the ventral part of the diaphragm. Thus the same mesodermal structure which develops into part of the pericardium, peritoneum, and diaphragm also supplies the liver with all its mesodermal tissue. Both on account of their intimate embryological relationship and their close apposition in the fully formed individual, it is to be expected that there would be communications between the blood vessels of the liver and of the diaphragm.

In view of the importance of these anastomoses, the nature of the blood supply to the

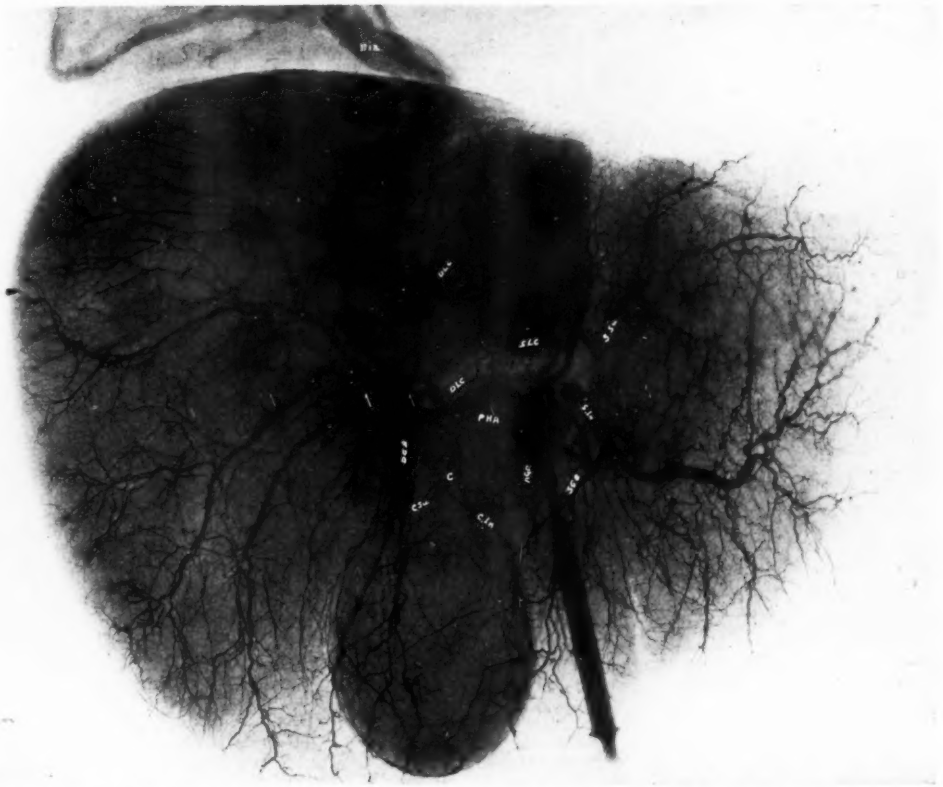

Fig. 4. Arteria hepatica, fifth decade. (A-6-22, male, age 55, died of bronchiectasis.) The arteries are quite tortuous, particularly in the left lobe. *a.g.d.*, Arteria gastrica dextra, anomalous origin close to bifurcation of propria; *p.h.a.*, the fine arteries and arterioles of the porta hepatis which anastomose with each other very freely; *c.*, the arteria cystica arises from ramus dexter and bifurcates into a dextrosuperior and sinistro-inferior branch which anastomose very freely with each other through their smaller branches. Due to the distended condition of the gall bladder its arteries are straight. *s.su.*, The superior division, and *s.in.*, the inferior division of the ramus sinister; *d.l.c.*, branches from the ramus dexter to the lobus caudatus; *s.l.c.*, branches from the ramus sinister to the lobus caudatus; *d.g.b.*, branches from the ramus dexter to gall-bladder region; *s.g.b.*, branches from the ramus sinister to gall-bladder region. Subcapsular branches of these vessels anastomose with branches of arteria cystica. *Dia.*, Diaphragmatic arteries injected during hepatic artery injection through anastomoses between phrenic and hepatic arteries. Arteria cystica divides into larger dextrosuperior, *c.su.*, and smaller sinistro-inferior branch, *c.in.*

diaphragm is worthy of note. This consists mainly of four arteriæ phrenicæ, namely, a dextra superior and sinistra superior which take origin from the aorta and distribute themselves to the thoracic side of the diaphragm, and a dextra inferior and sinistra inferior which do not arise in any consistently regular manner but may spring from the aorta itself or from the arteria cœliaca, arteria mesenterica superior or from any of their branches and occasionally one or the other of these phrenic arteries arises from a renal or suprarenal artery. In addition to the four arteriæ phrenicæ, the diaphragm receives quite large arteries from branches of the internal mammary (arteria pericardiophrenica, arteria musculophrenica, and arteria epigastrica superior), from the lower five to seven intercostals and from the first and second lumbar arteries. All these vessels which enter the substance of the diaphragm anastomose very freely with each other within it. In addition to

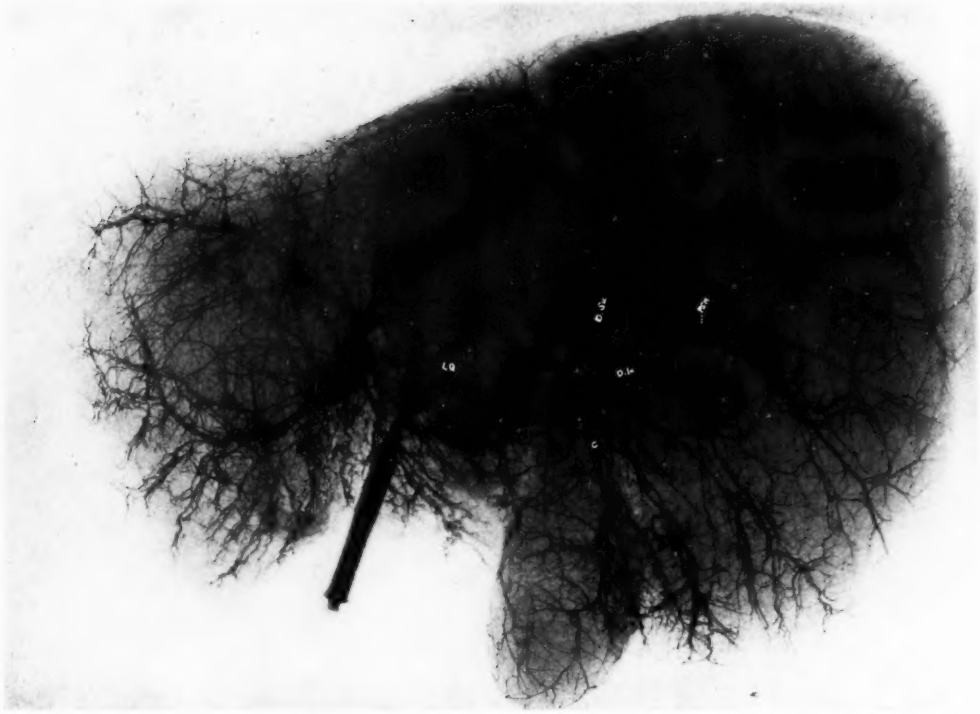

Fig. 5. (182-21, arteria hepatica, fifth decade. Female, age 53, died of peritonitis.) Note the tortuosity of the branches, most marked in the left lobe. In the stereoscopic view this picture resembles a bare old apple tree. *l.q.*, The artery to the lobus quadratus which arises from the ramus sinister simulates a figure 3 turned sideways, in its course to the lobe. *d.su.*, The superior division of the ramus dexter is smaller than *d.in.*, the inferior, but it is larger than usual. The inferior division gives off a series of four large branches at regular intervals, then terminates by dividing into two moderately large arteries. *p.s.a.*, Small arteries and arterioles are seen running parallel to their parent vessels. These supply the portal sheath and its contents. They anastomose freely with each other, as may be seen to better advantage in the stereoscopic picture and most clearly in the dissected specimen. *c.*, Arteria cystica.

anastomosing with branches of the arteria hepatica they also form communications with branches of bronchial and pleural arteries, œsophageal arteries and with capsular arteries of the suprarenals and kidneys and finally in the peritoneum of the lesser omentum, branches of the arteriæ gastrico dextra and sinistra anastomose with the diaphragmatic arteries. The presence of all these anastomoses is no less and no more surprising than the existence of the collaterals between hepatic and phrenic arteries; for the pleuræ, pericardium, muscles of the thoracic wall, the lesser omentum together with the falciform ligament and the interstitial tissue of the suprarenals and kidneys are derived from the mesoderm of the septum transversum just as the anterior portion of the diaphragm, Glisson's capsule and the interstitial tissue of the liver are developed from this embryonic structure. Thus the anastomosing diaphragmatic arteries establish far-reaching communications between branches of the thoracic and abdominal portions of the aorta.

THE VENA PORTÆ

The main tributaries of the vena portæ are the venæ mesentericæ inferior and superior and the vena lienalis. The vena portæ itself is a wide vein measuring 1.5 to 2 centimeters in diameter and about 6 to 8 centimeters in length. In the human adult, it commences at

the union of the vena mesenterica superior with the vena lienalis and ascending anteriorly to the vena cava inferior and posteriorly to the pancreas and duodenum it reaches the lower border of the foramen epiploicum (Winslow) where it passes forward in the right gastropancreatic fold of peritoneum and enters the ligamentum gastrohepaticum. In this it lies posterior to the bile duct and hepatic artery until it reaches the right third of the porta hepatis, where it widens into the sinus venæ portæ at its bifurcation into a shorter right and longer left branch. While coursing in the ligamentum gastrohepaticum, it receives the venæ gastricæ dextra and sinistra. The vena cystica joins the main stem of the vena portæ or its right branch; in our series of 55 livers, it joined the right branch in 88 per cent of cases. From the main stem from the sinus at its bifurcation and from its branches spring vessels which accompany the arteries given off by the arteria hepatica propria and its branches. Occasionally, however, branches go from the portal vein into liver substance alone and are joined by their accompanying arterial vessels only after they have pierced the liver. Branches are injected as far as the seventh order considering the right and left main division as branches of the first order. Those of the fourth and more especially those of the fifth and sixth orders divide dichotomously into equal sized vessels forming arches with angles of about 80° to 100°. The change in size from the first to the fifth order of vessels is gradual, but from the fifth to the sixth and seventh orders more sudden (Fig. 11), as was first observed by Gross in 1919 (17).

In view of the fact that the branches of the portal vein and of the bile ducts run along together with those of the hepatic artery, it follows that the nature of their gross distribution is similar in all three systems. In the seven livers injected through the vena portæ, the right inferior branch was the larger in five and the inferior and superior were of about equal size in two instances. The left inferior was the largest in six and the superior in one instance. The large branch to the lobus quadratus invariably sprang from the left main division, while the right main division was joined by the vena cystica in every case.

Fig. 6. Glisson's capsule. A portion of Glisson's capsule removed from the superior surface of a liver the hepatic artery of which was injected. The capsule was cleared with oil of wintergreen and then photographed. Note the abundant anastomoses of subcapsular and capsular arteries and arterioles. Where the continuity of vessels is broken the missing parts remained on the liver during the stripping off of the capsule.

The vena cystica, which drains venous blood from the gall bladder into the portal vein, courses on the anterosuperior surface of the gall bladder and between it and the liver substance along a variable length; it has two more or less equal main tributaries, one of which drains principally the gall bladder, while the other drains liver substance just above this organ. Occasionally (in two of our cases) the main vena cystica is partially embedded in liver substance and emerges only in the fossa for the gall bladder. Branches of the vena portæ which distribute themselves in the liver substance around the gall bladder send a variable number of larger and smaller veins into this organ, while both branches of the vena cystica send vessels into liver substance. The veins of the gall bladder anastomose with each other just as freely as the branches of the cystic artery (Fig. 12). Thus an anastomotic communication is formed between branches of the right and left divisions of the portal vein.

Terminal venules of the fifth, sixth, and seventh orders end beneath and in Glisson's capsule, but they do not anastomose with each other as the subcapsular arteries and arterioles do. These venules seem to end in capsular capillaries among which anastomoses must exist. Venules from the surface enter the peritoneal ligaments between the diaphragm and liver and there anastomose very freely with diaphragmatic venules, so that the

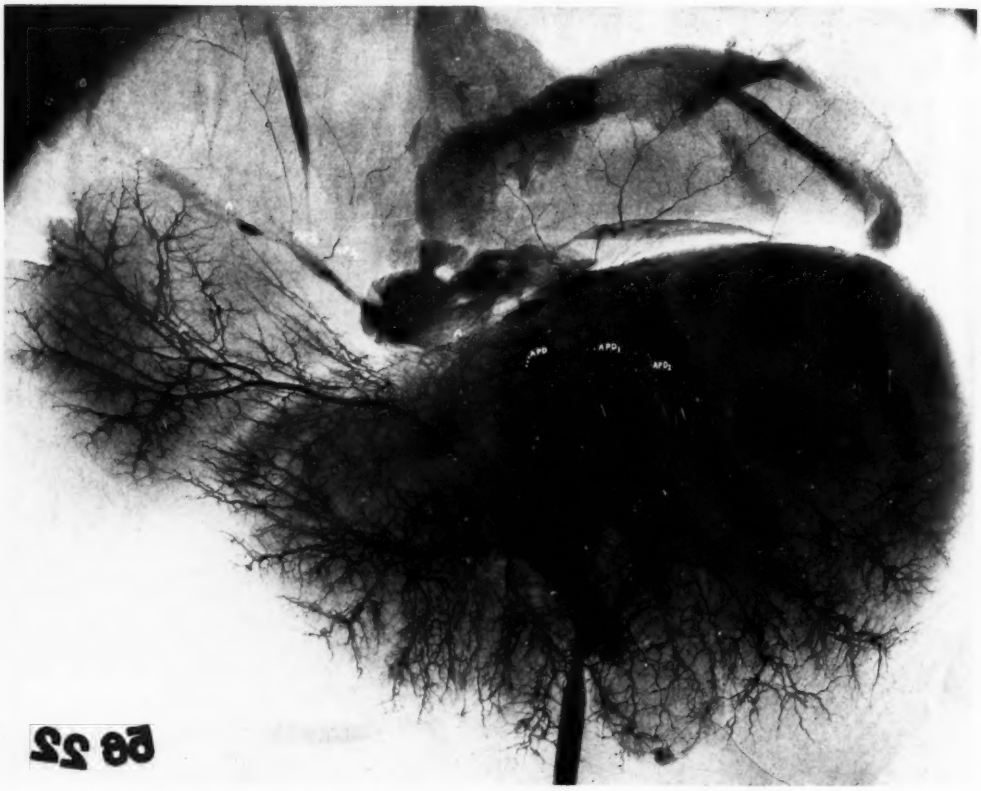

Fig. 7. Arteria hepatica, fourth decade. (A-57-22. Female, age 41, cerebral endothelioma in frontal region.) The left lobe has an appendage of normal liver substance, about the size and shape of an average adult kidney. Connecting the appendage to the left lobe is a thin, almost transparent, strip of tissue consisting of two layers of peritoneum and Glisson's capsule and some scattered small flat masses of liver substance. (One other liver with a similar but smaller appendage occurred in our series of 55 specimens.) The arterial tree was injected through the arteria hepatica propria and as the greater part of the diaphragm was still attached to the liver its arteries became injected with the fluid. Note the fine anastomoses *a*, *a*, *a*, between superficial arteries and arterioles of hepatic and phrenic origin in the coronary ligaments and also those between diaphragmatic arteries proper. *a.p.d.*, Arteria phrenica dextra inferior. *a.p.d.*[1], *a.p.d.*[2], Mesial and lateral branches of the arteria phrenica dextra inferior. *a.p.s.*[1], *a.p.s.*[2], Large branches of the arteria phrenica sinistra inferior.

phrenic veins become filled with emulsion when the vena portæ is being injected. Similar anastomoses exist throughout the entire bare area on the posterosuperior surface of the right lobe. As in the case of the arteria hepatica, the injection of one or the other of the main branches of the vena portæ leads to complete injection of the entire venous tree. The path of collateral circulation between the right and left divisions of the vena portæ was demonstrated by an experiment similar to that performed in determining the course of compensatory circulation between the rami dexter and sinister of the arteria hepatica propria. The emulsion was injected through the left division of the vena portæ during about half the time required completely to inject the entire venous tree. The stereoscopic pictures of this injection showed the entire system of veins in the left lobe, quadrate lobe, gall bladder, and left half of caudate lobe completely filled, while several large portal branches in the right lobe near the gall bladder were partially filled. The main right division con-

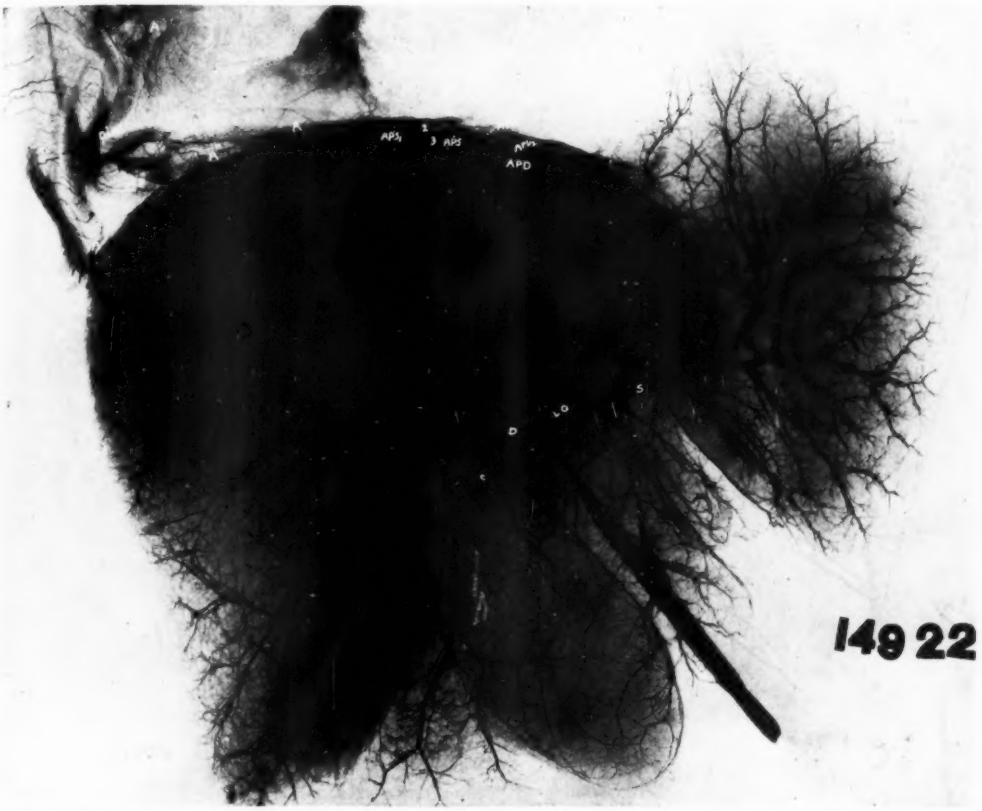

Fig. 8. Injection through the ramus dexter alone, with arteria cystica ligated. Third decade. (A-140-22. Female, age 34, died of peritonitis.) The ramus sinister arteriæ hepaticæ propriæ, its branches to the lobus quadratus and the arteria cystica just beyond its origin from the ramus dexter were ligated separately. The ramus sinister was severed near its point of origin. The cannula was inserted into the ramus dexter and tied beyond the point of bifurcation of the propria, so that the injection mass was forced in only through the ramus dexter. Note the complete injection of all branches of both rami including the arteria cystica. This picture shows that the intrahepatic arteries in the third decade of life are as yet quite straight. *a.p.d.*, A short stump of the main stem of the arteria phrenica dextra inferior and portions of two of its branches *a.p.d.*[1], *a.p.d.*[2], *a.p.s.*, The main stem of the arteria phrenica sinistra inferior and its three branches, *a.p.s.*[1], *a.p.s.*[2], *a.p.s.*[3]. *Dia.*, A portion of the diaphragm showing the abundant anastomoses among its arteries and arterioles. *a.*, *a.*, *a.*, Anastomoses between arteries and arterioles of phrenic and hepatic origins. Note the important anastomoses in the region of the gall bladder and porta hepatis, *p.h.*, as well as those in the fossa umbilicalis, *f.u.*; *d*, ramus dexter; *c.*, arteria cystica; *s.*, ramus sinister; and *l.q.*, branch of ramus sinister to lobus quadratus.

tained a small amount of emulsion. The collaterals are therefore in the hilus and in the gall bladder where branches of the left main division of the vena portæ coming from the lobus quadratus anastomose with those of the right coming from the vena cystica and the vessels of the right lobe of the liver around the gall bladder. There are no subcapsular anastomoses to assist in the collateral circulation between the different branches of the vena portæ. For a fluid with a viscosity such as that of blood, the collaterals are, however, not limited to the anastomotic courses just described for the capsular capillaries, and the peripheral capillaries around the lobules anastomose freely with each other and with those of neighboring lobules, so that a wide range of extrahepatic and intrahepatic col-

Fig. 9. Injection through ramus sinister alone, sixth decade. (A-63-22. Male, age 65, encephalomyelitis.) The ramus dexter arteriæ hepaticæ propriæ was ligated just beyond its origin from the point of bifurcation of the propria. The cannula was inserted into the ramus sinister and tied beyond the origin of the artery from the propria, so that the barium sulphate-gelatine emulsion was injected only through the ramus sinister. Note the complete injection of all branches of both rami sinister and dexter as well as some diaphragmatic vessels. In this liver from a man in the sixth decade of life the arteries are everywhere markedly tortuous. Compare with Figure 3, for second decade; Figure 8, for third; Figure 7, for fourth, and Figure 5, for fifth decade. *r.*, Ramus dexter; *s.*, ramus sinister; *g.b.*, gall bladder; *Dia.*, diaphragm.

laterals come into play when the portal circulation of one part of the liver must compensate for that of another. The fact remains, however, that a large majority of the branches of the portal vein do not take part in vein-sized or venule-sized anastomoses.

The collateral circulation of the vena portæ, both as regards draining portal blood into the systemic veins and supplying the liver with it from accessory portal veins in the lesser omentum, has been thoroughly investigated and is described in standard books on the anatomy and physiology of the liver as well as in surgical and pathological treatises dealing with obstruction of vena portæ from thrombosis, pressure, cirrhosis, etc. We consider it worthy of noting here that in 35 per cent of our series of 55 livers the umbilical vein was patent in more than two-thirds of its length and its lumen communicated with that of the left division of the vena portæ in all of these instances. It is a significant fact that the organs and tissues which are supplied with arterial blood by the arteria cœliaca, the arteria mesenterica superior and the arteria mesenterica inferior are drained of their venous blood principally by the portal system of veins and while these arteries are all connected up by a large series of anastomoses which take place between their smaller branches, the smaller tributaries of the portal system also form a continuous series of anastomoses.

Fig. 10. Short-time injection through ramus dexter alone with partial filling of the branches of the ramus sinister. (A-135-22. Infant, 9 months old; died of malnutrition.) The injection was made through the ramus dexter arteriæ hepaticæ propriæ alone, and continued only for 4 minutes, i.e., about half the time required to inject the entire arterial tree. Roentgenogram showed complete injection of all branches of the ramus dexter, but only the larger branches (first, to fifth and sixth orders) of the ramus sinister were filled. Note the complete injection of capsular and subcapsular arteries over right lobe and only very few over left lobe, near its right border. (Some of the vessels are tortuous because of shrinkage of the capsule due to formalin fixation.) The vessels to tissues of the porta hepatis were more completely injected in the right than in the left half. (See "Collateral Circulation between Ramus Dexter and Ramus Sinister.")

Fig. 11. Vena portæ. (A-166-21. Infant, 9 months old; died of malnutrition.) Portal vein injected. Note the wide sinus at the bifurcation of the vena portæ into a short right and a longer left division. The sinus and both divisions before they enter the substance of the liver give off branches to the lobi caudatus and quadratus. The branching is dichotomous, the vessels show no tortuosity, the diminution in size is quite gradual as far as the fifth order of branching, then it becomes more sudden. The gall bladder is collapsed and very small so that its anastomosing system of veins cannot be clearly made out except in a stereoscopic view of this picture. (For Vena Cystica see Fig. 16.) *s.*, Sinus; *r.*, right division; *l.*, left division.

Furthermore, both the vena portæ and the arteria hepatica, which is a branch of the arteria cœliaca, anastomose with phrenic vessels, thus forming a communication between the thoracic and abdominal circulations.

The embryological explanation given above for the latter arterial communications may also be applied to the venous anastomoses in the diaphragm.

THE VENÆ HEPATICÆ

The venæ hepaticæ drain the blood from the liver directly into the vena inferior, entering this vein just before it passes through the diaphragm. The radicals of the hepatic veins converge to form three large groups: a right, draining the right lobe; a middle group, draining the mid-portion of the liver, lobus caudatus and lobus quadratus; and a left group draining the blood from the left lobe. Where the vena cava lies in direct contact with liver surface, it also receives numerous small veins from liver substance. Considering the largest main vein of one of these three groups as a branch of the first order, then seven orders of branching are found injected with barium emulsion, the seventh order being the sublobular veins into which empty the central veins of each lobule. Here and there some central veins are seen to be filled with emulsion forming an eighth order of branching. The fifth to the eighth orders of veins join with each other to form arches with angles of about 80° to 100°, similar to those of the vena portæ. The larger radicals, however, those of the second, third, and fourth orders, converge more acutely toward the main vein forming angles of 20° to 45° at their junctions. The diminution in size of vessels is similar to that of the branches of the vena portæ; as far as the sixth order it is gradual; then it becomes much more sudden and pronounced.

In the four livers injected through the venæ hepaticæ, the gall bladder presents only very few small venules containing emulsion (Fig. 12). This appears to be a conclusive proof of the fact that the vena cystica and the other smaller branches of the vena portæ, described

Fig. 12. Venæ hepaticæ. The cannula is in the vena cava inferior near the point of its entrance into the right auricle. The portion of the inferior vena cava that is intimately attached to the inferior surface of the liver is filled with emulsion; this, together with the close approximation of the hepatic veins to each other as they enter the vena cava inferior accounts for the dense shadow with little or no detail in the upper half of the mid-portion of the liver in this photograph. The three groups of veins, the left, middle, and right, are, however, apparent. Note the angles formed by the union of the seventh, sixth, and fifth orders (60° to 90°) and the more acute angles formed by the junction of the larger veins (20° to 60°). The shadow of the moderately distended gall bladder is evident; note the very few small veins injected. *d.*, Right group; *m.*, middle group; *s.*, left group; *g.b.*, gall bladder; *v.c.i.*, vena cava inferior; *p.*, *p.*, phrenic veins.

above, as entering the gall bladder, drain by far the greater part of the venous blood of the gall bladder.

THE BILE CHANNELS

The excretory ducts of the liver begin as little canals (ductus interlobulares) which unite to form larger and larger channels and ultimately end in two or more chief branches which emerge from liver substance into the porta hepatis. The two largest of these latter channels come from the right and left lobes (rami dexter and sinister hepaticus) and are joined by several smaller ducts from the lobus caudatus and lobus quadratus. When the union of these ducts, to form the ductus hepaticus, takes place in the vicinity of the right third of the porta hepatis, then the left main duct receives most or all of the smaller ones before it joins with the right duct. The converse of this is also true but occurs less frequently. Occasionally the union takes

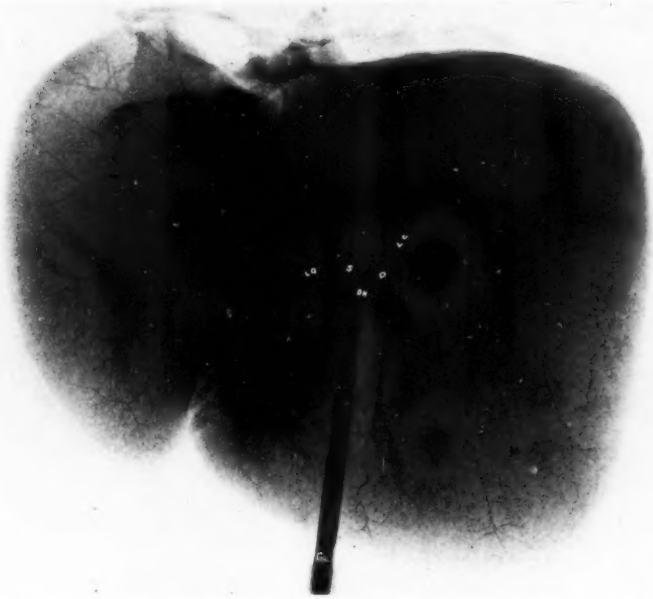

Fig. 13. Ductus hepaticus. (A-81-22. Male, aged 7; died of diphtheria.) The gall bladder was collapsed and empty. On squeezing the liver, no bile flowed from the ductus choledochus. The cannula, *g.c.*, was inserted into the ductus hepaticus, *d.h.*, proximal to its junction with the ductus cysticus. *d.*, Ramus dexter ductus hepaticus; *s.*, ramus sinister ductus hepaticus; *l.q.*, tributary from lobus quadratus emptying into ramus sinister; *l.c.*, a large tributary from lobus caudatus emptying into ramus dexter near its point of union with the ramus sinister to form the ductus hepaticus.

place opposite the middle third of the porta hepatis, and then the left duct receives all of the smaller channels from the lobus quadratus and some of those from the lobus caudatus. while the point of union and the right duct receive the remaining small ducts.

The bile duct systems of six livers were injected by the method described above. Considering the rami dexter and sinister ductus hepaticus as branches of the first order, seven orders of branching were filled with emulsion. The general characters of the branching are similar to those of the arteria hepatica and vena portæ. The two branches of the second order on each side appear to be an anterior (usually the larger) and a posterior rather than an inferior and superior as is the case with the corresponding branches of vein and artery. The anterior was the largest in five cases on the right side, and in a similar number of cases on the left side, while the two branches were of about equal size in one case on the right and in another case on the left side. In all instances the channels of the caudate as well as those of the quadrate lobe unite before joining with the main left or right branch. In two instances a separate larger vessel begins in the quadrate lobe, drains liver substance around the gall bladder and ends in the right main duct.

INFARCTION OF THE LIVER

In the absence of any accessory hepatic arteries or of unusually large arterial collaterals, more or less sudden total obliteration of the flow in a normal arteria hepatica propria will be followed by necrosis of the liver. This fact, so far ascertained only experimentally on rabbits, dogs, and cats, strongly emphasizes what has already been stated above, namely,

Fig. 14. Arteria hepatica in a case of metastases of carcinoma in the liver. (A-8-22. Male, age 42; carcinoma of lung.) The uniformly black areas represent nodules completely surrounded by extravasated emulsion. The small nodules show the anastomosing arteries about their periphery and penetration of arteries toward centers.

that arterial oxygenated blood is essential to the health and very life of liver substance. Because of the abundant collaterals between the rami dexter and sinister (see "Collateral Circulation between Ramus Dexter and Ramus Sinister"), obstruction of either of these arteries leaves the liver in its normal condition. Obliteration of the arterial flow in the branches of either ramus sometimes is and sometimes is not followed by infarction of the part supplied by the obstructed vessel. The explanation for these phenomena is to be found in the nature of the distribution of anastomoses and in the path followed by collateral circulation between various branches of the two rami.

As was pointed out above, the blood follows the course of least resistance from the patent large vessels into the nearest anastomoses between it and the obstructed vessel, thence into the latter vessel and finally into all the ramifications of the obstructed branch. Those intrahepatic branches of the two rami which have subcapsular ramifications necessarily have collaterals through the surface anastomoses and when one of these vessels is obstructed, liver substance supplied by it does not suffer any change. On the other hand, the arterial branches which end within liver substance and do not take any part in the subcapsular communications have only an extremely

limited course of collateral circulation from the anastomosing small vessels in the portal sheath and around the portal vein, bile ducts, and nerves. Only when a very small artery is blocked at a point between the origins of some of these small vessels can the anastomoses between the small arterioles arising proximal and distal to the point of obstruction be expected to function as efficient collaterals. If the lumen of a larger artery without subcapsular collaterals is obliterated, then there must follow infarction of the intrahepatic area supplied by this vessel. Hence the great frequency with which infarcts of liver do not involve the surface and are discovered only on sectioning the organ. These infarcts are at first hæmorrhagic from stagnation of portal and venous blood, but the liver substance undergoes necrosis and portal vessels become obliterated by thrombi, the infarct becomes white both from anæmia and from the color of necrosing and autolysing tissues. If the individual lives long enough after the occurrence of the obstruction, the infarct heals by granulation tissue formation (Kaufmann).

THE HEPATIC ARTERY IN A CASE OF PERI-INSULAR CIRRHOSIS

Only one case of peri-insular cirrhosis came to our attention during the course of this study. The hepatic artery was injected in the usual manner. The stereoscopic picture revealed extremely tortuous intrahepatic arteries, some of the vessels actually resembling corkscrews which taper at their distal ends. The subcapsular arteries and arterioles were particularly abundant and they anastomosed with each other very freely.

It is interesting to note that the process by which the liver becomes altered in its general architecture in cases of cirrhosis is analogous to that by which it is altered in the fetus from a simple tubular gland in which the secreting cells are arranged around the excretory bile ducts to one made up of lobules surrounded by fibrous tissue containing nutrient and functional vessels and ducts and with the lobular cells arranged around the central collecting veins. In both cases it is essentially a growth of mesodermal fibrous connective tissue which produces the altered framework

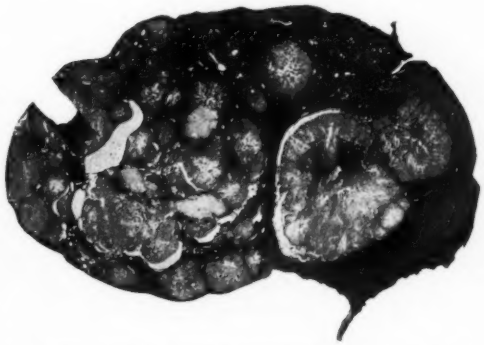

Fig. 15. Arteria hepatica in a case of metastases of carcinoma of the lung, in the liver. From same case as shown in Figure 14. Photograph of the cut surface after injection. Note the mantles of extravasated emulsion around the cancer nodules in the tissues which had undergone pressure necrosis. The cancer metastases contain injected arteries arranged in more or less radiate fashion.

and consequently the altered arrangements of liver substance. The changes in the course of the development of the human liver can be understood both on a basis of the *a priori* consideration that they consist of phylogenetic gradations proceeding ontogenetically and from the *a posteriori* knowledge that the liver is essentially a gland of internal secretion with the hepatic vein as its main excretory duct. This diminution in the importance and significance of the external secretion in the liver simulates the changes in other glands of internal secretion which lead to total obliteration of the external excretory system, as e.g., in the thyroid, which normally retains only a vestige of its thyroglossal ducts in the form of a thin, fibrous cord.

THE DISTRIBUTION OF BLOOD AND BILE CHANNELS IN CASES OF METASTASES OF NEW-GROWTHS IN "THE LIVER"

Two livers which were the seat of numerous cancer metastases and one of metastases of hypernephroma, are included in the 55 livers studied. In one, the hepatic artery was injected; in the second, the portal vein; and in the third, the bile-duct system.

The stereoscopic pictures of the hepatic artery and portal vein injections present numerous large areas which are uniformly opaque to the X-rays (Figs. 14, 15, and 16).

Fig. 16. Vena portæ. Liver contains metastases of carcinoma. (A-37-22. Female, age 41, general carcinomatosis from primary carcinoma of the breast.) Vena portæ injected. The metastases of carcinoma in the liver are surrounded by mantles of barium sulphate-gelatine emulsion, which become extravasated about the nodules in the tissues which underwent pressure necrosis. In the stereoscopic view no branches of the vena portæ were seen to be distributed within metastases. The veins of the gall bladder, *g.b.*, are very well seen in this picture. Note the intimate anastomoses among the veins in the bladder wall and the presence of large veins in its vicinity coming from both right and left divisions which contribute veins that take part in the anastomoses that are evident. Thus these anastomoses contribute to the collateral circulation between the right and left divisions of the vena portæ.

These are due to the extravasation of barium sulphate emulsion in the softened necrotic tissues around the larger cancer masses. In the hepatic artery preparation, the smaller cancer nodules show to best advantage the nature of the distribution of arterial vessels to the tumors. Larger branches are arranged around the nodule and these give off smaller ones which course in the substance of the metastases and are arranged in radiate fashion. The arteries around the periphery of the nodule anastomose with each other here and there, while those within it also present a number of anastomoses. In the case of cancer which we observed, the portal vein does not send any vessels into the interior of the cancer nodules. The larger nodules are surrounded by mantles of extravasated emulsion but show no filled vessels within their substance. The smaller nodules show no trace of barium around them. The liver with metastases of hypernephroma was injected through the bile ducts. No ducts were found in the tumor masses. Some of the branches were somewhat distorted in their course by pressure from the nodules.

It is, of course, impossible to draw conclusive deductions from such a small number of cases, but these results are very suggestive of the fact that portal blood takes no part in

the nutrition of tumor metastases and that bile ducts are either entirely replaced or pushed aside by metastases of new-growth within the liver, while arterial blood alone is responsible for the nutrition of the metastases.

THE COMPENSATORY ARTERIAL CIRCULATION OF THE LIVER IN RELATION TO SURGICAL LIGATURE OF THE HEPATIC ARTERY

Cohnheim and Litten, in 1876, ligated all the arterial branches going to the liver, in the ligamentum hepato-duodenale of rabbits and found that necrosis followed, involving the whole liver. When only a single branch was tied, the lobe which it supplied became necrotic, while the remainder of the liver was not affected in any way. These observations have since been repeatedly corroborated. Haberer, in 1905, and more recently in May, 1922, Behrend and his associates found the same phenomena in guinea pigs as well as in rabbits. Haberer also showed that whereas in rabbits and guinea pigs ligation of a branch of the hepatic artery produces infarction, in dogs and cats the liver substance suffers no change. Litten, in 1890, observed animals as long as three days after tying the hepatic artery and expressed the opinion that the liver could better afford to do without the blood of the portal vein than without that of the hepatic artery. The surgeon Haberer, in his excellent work on experimental ligation of the hepatic artery, found that in dogs, the hepatic circulation of which simulates very closely that of the human liver, tying off the arteria hepatica propria resulted in necrotic changes in the liver which were usually followed by death within 72 hours. In those dogs which survived for a longer period of time and in those that appeared to be unaffected by the operation, he was unable to demonstrate by postmortem examination that the livers of the former series showed only small, scattered, necrotic foci, whereas those of the latter series showed no regressive changes whatsoever. In both these types of cases he demonstrated by means of injection that there existed collaterals from phrenic arteries which he traced in the coronary ligaments as far as Glisson's capsule whereas he found few or no such collaterals in those animals which died within

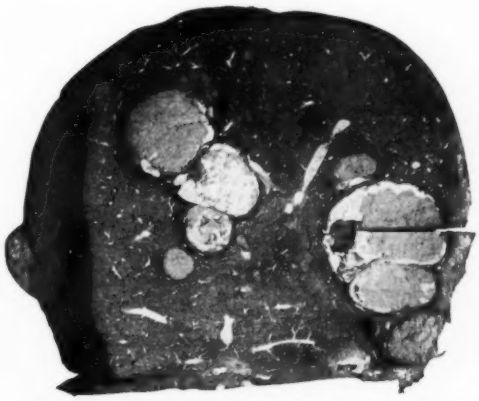

Fig. 17. Vena portæ. (Same case as shown in Figure 16.) A photograph of the cut surface of the same liver represented in Figure 16, showing the mantles of extravasated emulsion around the periphery of the cancer nodules, and the absence of any injected vessels within the cancer masses. The smaller nodules with no mantles of emulsion around them show isolated injected branches of the portal vein in the liver substance adjacent to them. Two nodules near the center and in the right half of the photograph were cut so as to show the mantle of emulsion which surrounded them.

72 hours. These experimental results seem to indicate very clearly that arterial oxygenated blood is essential to the nutrition of hepatic cells.

In the course of abdominal operations surgeons may occasionally meet with conditions of the hepatic artery such as aneurism, trauma, etc., which may call for ligation of this vessel. A considerable number of the 56 reported cases of aneurism of the hepatic artery simulated cases of obstructive jaundice from cholelithiasis, and the true cause of obstruction was discovered only after laparotomy or at autopsy (Rolland; Friedenwald and Tannenbaum).

Such a case was reported by Kaeding in 1919, in which Professor Sudick ligated the artery and the patient recovered. This is the second reported case of recovery following treatment for aneurism of the hepatic artery by ligature. The first was that of Kehr, in 1905.

Holst, in 1921, reported a case in which the hepatic artery was cut during a difficult resection of the stomach. The artery was ligated, the man recovered from the operation which lasted four and a half hours and

appeared to be convalescing favorably, when he suddenly began to grow weak and died eight and a half days after the operation. Holst ascribes the death to necrosis found in the left lobe and accounts for the fact that the right lobe was well preserved by the presence of a small artery in the ligamentum teres. The exact distribution and extent of the necrosis are not described so that it is difficult to discuss this case in the light of our own observations. More recently, Smith, in April, 1921, and Hoffmeister, in February, 1922, reported two cases in which the hepatic artery was cut accidentally during surgical procedures in the epigastric region; in both cases the artery was ligated and the patients made uneventful recoveries. Smith's patient, a woman aged 57, was in good health six months after the operation but was treated medically for acute infection of the gall bladder a month later and again recovered. Hoffmeister's patient was able to get out of bed for a drink 48 hours after the operation and on the sixteenth day showed no signs or symptoms of injury to the liver.

In the case of aneurism of the hepatic artery reported by Tuffier, death took place 3 days after ligation of the artery but no necrosis was found in the liver.

Ledieu in 1856 reported a case of aneurism of the hepatic artery which was completely blocked by a thrombus. The description does not allow one to form a clear conception of the exact position of the aneurism with reference to the arteria gastrica and arteria gastroduodenalis. It was an accidental finding at autopsy, and the liver was not altered as a result of the completely obstructed hepatic artery. In Merkel's case, a dissecting aneurism involved a portion of the arteria hepatica communis including the origins of the arteria gastrica dextra, the arteria gastroduodenalis and the arteria hepatica propria. The aneurism contained a large, firm, canalized thrombus which partially blocked the communis. There was, however, free communication between the latter three arteries through channels in the thrombus, so that the arterial circulation of the liver was maintained largely by collaterals from branches of the mesenteric arteries anastomosing with branches of the arteria gastrica dextra and arteria gastroduodenalis, as well as by the diaphragmatic collaterals. This aneurism also was an accidental finding at autopsy, and the liver did not show any lesions referable to the blocking of the hepatic artery.

The possible necessity of ligating the hepatic artery raises the question as to what are the collateral vessels that will afford a compensatory arterial circulation to the liver and to what extent can they be depended upon to maintain the liver in a healthy state. In this connection, we, first, quote the following significant passages from Haberer's thorough review of the important literature on this subject up to 1905: "On the basis of more theoretical considerations and supported by definite anatomical knowledge about the question, Langenbuch, whose opinion upon the surgery of the biliary tract is highly valuable, expressed the opinion that with the development of collateral branches to a suitable degree, tying of the hepatic artery without much damage being done must be possible. Besides the well-known communications between the branches of the arteria cœliaca and between them and the arteria mesenterica superior, he draws attention to the 'stepmother like treated' (*Stiefmuetterlichbehandelten*) phrenic arteries from which branches are normally given off to the liver."

Langenbuch's statement with regard to the more or less neglected collaterals from the phrenic arteries is corroborated both by Haberer's experimental results and by the evidence obtained from our series of 37 human livers injected through the hepatic artery. As was mentioned above, the phrenic arteries during injection of the hepatic artery, became filled with emulsion through their anastomoses with the surface branches of the hepatic artery, in every instance of our series, which includes injections through ramus dexter and ramus sinister alone as well as through arteria hepatica propria. Haberer attributes the absence of areas of necrosis in the livers of some animals in which the arteria hepatica propria was tied, to compensatory circulation through collaterals from phrenic arteries which he demonstrated by injections. Behrend and his associates ligated the hepatic artery in dogs and cats

and found that these animals "continue to live indefinitely in spite of a combination of peripheral and central ligation." On co-ordinating the results of the following four of their experiments the rôle played by the diaphragmatic arteries in the collateral arterial circulation of the liver becomes clearly apparent:

1. A cat in which the hepatic artery was ligatured centrally (near its origin) was killed 19 days after the operation. The liver cells generally showed hydropic degeneration but were best preserved in the subcapsular areas.

2. Another cat similarly prepared was killed 113 days after the operation. Sections of the liver showed practically no pathological lesions whatever.

3. After ligating both the hepatic artery, centrally, and also the diaphragmatic arteries, the animal recovered and was killed on the sixty-third day after the operation. Sections of the liver showed "irregular focal necroses around the central parts of the lobules and hydropic degeneration in their periphery. The blood vessels were somewhat dilated. It is quite probable that if the animal had been allowed to live long enough the collaterals from the right gastric and gastroduodenal arteries would have developed sufficiently to fulfil all the normal needs of the liver. Moreover, the diaphragmatic anastomosis would in time also take part in the collateral circulation to the liver because of the anastomoses between branches of the phrenic arteries with other branches of the thoracic aorta.

The only animal of the entire series which succumbed to the operation was one in which the hepatic and diaphragmatic arteries were ligated. The cat died 48 hours after the ligation and its liver showed "universal necrosis."

Thus, from anatomical evidence obtained from the study of human livers and from the experimental results of Haberer and Behrend, *et al.*, it is deduced that the anastomoses between the branches of diaphragmatic arteries and those of the hepatic artery (in the regions described in a previous chapter of this communication), play an essential rôle in the collateral arterial circulation of the liver.

The well-known anastomoses which Langenbuch refers to as existing between the branches of the arteria cœliaca and between them and those of arteria mesenterica superior are fully described in standard books of anatomy. In general, it is permissible to state that there exists a continuous chain of anastomoses between all the branches of the arteria cœliaca and that some of the links in this chain anastomose with certain branches of the arteria mesenterica superior.

Haberer investigated the relative importance of various groups of these anastomoses with reference to the ligation of the hepatic artery experimentally on dogs and cats and came to the following conclusions:

"1. The arteria hepatica communis in its main stem may be ligated without fear for the nutrition of the liver."

(This conclusion is very well supported by Merkel's case of an aneurism of the arteria hepatica communis which was almost completely blocked by thrombus formation. The arterial circulation of the liver in this case was maintained mainly by collaterals from the right gastric and the gastroduodenal, and also from the diaphragmatic arteries.)

"2. Ligation of the arteria hepatica propria before it gives off the arteria gastrica dextra usually should not hurt the nutrition of the liver.

"3. Ligation of the propria distal to the origin of the arteria gastrica dextra when the hepatic artery is previously healthy results in more or less extensive necrotic changes and eventually total necrosis is a probable outcome that must be feared. But if the artery is diseased then it is permissible to ligate at this point with freedom from fear of untoward results, because one can count upon a previously developed collateral circulation.

From these conclusions it appears that, in tracing the effect of ligation at various points along the course of the hepatic artery commencing at the arteria cœliaca, the nearer the point of ligation is to the bifurcation of the propria the greater will be the danger of necrosis. Furthermore, the danger of necrosis in human livers diminishes in ligation of single branches distal to the bifurcation with the exception of those branches which end within the liver and therefore do not participate in the subcapsular anastomoses.

It is logical to assume that a gradually increasing partial obstruction to the arterial flow in a given artery will cause its collateral circulation to become correspondingly more and more developed, until this is capable of replacing the previously normal source of arterial blood to the part. Such a compensatory circulation may result from an aneurism, especially from a healing aneurism, or from pressure upon the artery from a neighboring tumor. The late Professor Halsted, of The Johns Hopkins University, produced the same effect by applying a partial ligature made of aluminum or of tape. These principles apply to the arteria hepatica propria and its collaterals including those from the diaphragmatic arteries. Therefore, it seems reasonable that when the necessity for ligating this artery is not an urgent one requiring immediate complete tying off and if the obstruction has only recently begun, or if the artery is still quite normal, conditions favorable for the widening of the existing collaterals may be produced by applying a partial ligature. However, if the natural cause of obstruction is one of long standing, such as a moderately large, partially healed aneurism which has caused an apparent widening and thickening of the artery proximal to it, it is safe to assume that the collaterals have already sufficiently developed and the propria or both its main branches, the ramus dexter and ramus sinister, may be ligated.

Kaeding refers to Baruck, Trunert, and Bode who suggest that in order to increase the number of collaterals, a preliminary operation consisting of the production of adhesions about the liver and compression of the aneurism should be performed before ligating the hepatic artery. In the opinion of Kaeding, this preliminary operation is not always necessary when the hepatic artery is the seat of an aneurism.

When the necessity arises for ligating a previously normal hepatic artery without delay as, for example, because of traumatic rupture or purulent necrotic changes of the arterial wall, then the surgeon must be encouraged by the frequent occurrence of anomalies which enhance the collateral arterial circulation of the liver. Haberer reports the presence of an arteria hepatica accessoria in 33 per cent of 75 cases in dogs; in these instances it arose most frequently from the arteria mesenterica superior, but also from the arteria gastrica sinistra and the spermatic or renal arteries. We found one or more arteriæ hepaticæ accessoriæ in 11 instances. In one of these cases in which the accessory artery sprang from the arteria gastrica sinistra, injection through the ramus dexter led to complete injection of all arteries of the liver, stomach, and duodenum, partial injection of the arteries of ileum, pancreas, spleen, and adrenals. If the injection had been made through the arteria gastrica sinistra in this case, no doubt the same result would have been obtained. Quite frequently an atypical origin and course of the arteria hepatica communis may favor and increase the efficiency of the normal collateral circulation. Thus when the rami dexter and sinister arise separately from the abdominal aorta, or from the arteria cœliaca and arteria mesenterica superior or even when the arteria hepatica communis is present and bifurcates very soon after its origin, the ramus dexter courses in the ligamentum gastrohepaticum alone, and if necessary it can be tied at any time in any part of its course and under any conditions of its walls without fear of causing regressive changes in the right lobe. Occasionally the arteria gastroduodenalis and the arteria gastrica dextra arise at or very near the bifurcation of the propria or directly from its rami. In such cases it is not at all dangerous to tie the hepatic artery at any point between the origin of the communis and the region of the bifurcation. The fact that no given artery distributes itself in exactly the same manner in any two or more cases, first enunciated by Frederick Ruysch, is now well established. The frequency with which anomalies of the hepatic artery occur which may enhance the collateral circulation of the liver must be most encouraging to the surgeon who is confronted with the task of ligating this vessel.

SUMMARY

The injection technique of Gross as applied to injecting the blood and bile channels of the liver is described.

The average normal and some anomalous types of extrahepatic branching of the arteria hepatica are described from the study of 55 livers.

The intrahepatic branches of the hepatic artery are quite straight in the earlier decades of life (up to fourth or fifth), but become more and more tortuous with advancing age.

The distribution of the intrahepatic branches of the rami dexter and sinister, arteria hepatica propria and of the arteria cystica is fully described from the study of 37 preparations.

The subcapsular arterial anastomoses and those in the tissues of the porta hepatis constitute the courses of the collateral circulation between the rami dexter and sinister.

Some intrahepatic arteries are end-arteries.

The course of collateral circulation between a patent and an obstructed branch of the hepatic artery is from the collateral vessels into their larger parent vessels (branches of the blocked artery), thence into the main branch as far as the point of obstruction and finally from this into all the ramifications of the blocked artery. This principle also applies to the collateral circulation between the right and left branches of the vena portæ.

The anastomoses which form the path of collateral circulation between diaphragmatic and hepatic arteries are described.

The intrahepatic branches of the vena portæ differ from those of the hepatic artery in their greater caliber and in the more sudden diminution in size from the fifth to the sixth and seventh orders of branching. There are no subcapsular anastomoses between the venule-sized branches of the portal vein. The anastomoses which are responsible for collateral circulation between the right and left branches of the vena portæ are as follows: venules in the tissues of porta hepatis, the perilobular and the subcapsular capillary anastomoses.

Those branches of the vena portæ which terminate within the liver do not take part in vein-sized or venule-sized anastomoses. Among those which terminate on the surface some form vein-sized or venule-sized anastomoses with other branches of the portal vein or with systemic veins (diaphragmatic, peritoneal, etc.), while others end similarly to those which terminate within the liver.

The venæ hepaticæ converge to form three groups: a right, a middle, and a left group. The angles formed by the junctions of the larger vessels are much more acute (15° to 40°) than those formed by the branching of the vena portæ (60° to 90°). The central group receives a few very small radicals from the gall bladder, the venous blood of which is drained mainly by tributaries of the vena portæ, principally the vena cystica.

The intrahepatic and extrahepatic courses of the bile ducts are described from a study of six preparations.

Arterial blood is absolutely essential to the nutrition of liver substance. Complete obstruction of either the ramus dexter or ramus sinister, arteriæ hepaticæ propriæ, does not effect any change in the liver substance normally supplied by the blocked vessel. The abundant anastomoses which afford the efficient collateral circulation in such cases are described.

Infarcts of the liver follow obliteration of those arteries which terminate in the liver without sending any branches to the subcapsular system of anastomoses, and which are therefore proper end-arteries.

In peri-insular cirrhosis, the intrahepatic arteries appear extremely tortuous, and the subcapsular anastomoses are particularly abundant.

In one case of metastases of new-growth in the liver, the hepatic artery gave branches to the tumor masses. In another case the portal vein was injected, but the tumor masses did not receive any branches from it, while in a third instance the injection of the bile ducts showed no evidence of ducts within the metastases.

The conclusions of Haberer with regard to surgical ligation of the hepatic artery are also true for man because of the close resemblance between the arterial circulation of the human liver and that of the dog and cat with which he experimented.

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SEGMENTAL RESECTION OF THE BLADDER FOR NEOPLASM[1]

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SEVEN years ago, in a paper read before the American Urological Association entitled "Radium Versus Surgery in the Treatment of Vesical Neoplasm," I concluded as follows:

"Therefore, in the light of our present knowledge, we believe that cures in bladder tumors by the use of radium may be hoped for only in benign papillomata; that it may be possible in certain instances to render the symptoms of vesical malignancy less distressing by intra-urethral, suprapubic, rectal, or cross-fire intra-urethral and rectal radiations; that by the time vesical carcinoma has been made clinically manifest the growth has extended too far to be readily influenced by the amounts of radium at present at our command; that the question of the best management of a case of vesical carcinoma is no different than the management of carcinoma anywhere else in the body—and such is, if the growth is anatomically accessible, wide surgical extirpation followed by every means known to science to treat any unremoved growth or recurrence.

"We may find, however, as further experience develops more ingenious means to use radium intravesically, that radiating the tumor before operation may lessen the danger of tumor transplants occurring at time of operation."

Summing up the experience of myself and others since then, it seems that we are even now only in an experimental stage in the use of radium diathermy, or high voltage X-ray, and that surgery must still be regarded as the method first in importance of therapeutic choice in the treatment of early vesical cancer.

Nevertheless, surgical treatment of malignant tumors of the bladder leaves much to be desired, and mainly so because the diagnosis is often masked by lack of symptomatology, until the tumor has grown to such an extent that complete surgical removal is out of the question.

However, accumulating evidence shows that vesical carcinoma is late in metastasizing outside of the bladder and that for a very considerable period may remain localized, this, of course, being the surgically favorable period.

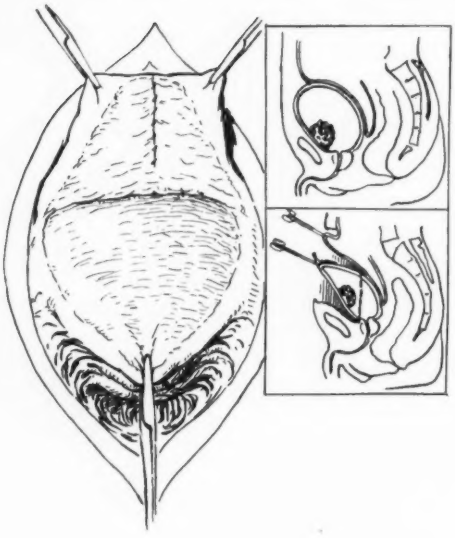
If we reflect that better surgical results in gastric carcinoma did not obtain until the type of operative removal was adapted to the lymphatic supply of the organ, and definite zones of lymphatic extension mapped out, we may fear that success in bladder surgery for tumor removal, if dependent for solution upon a similar problem, may never produce as good results.

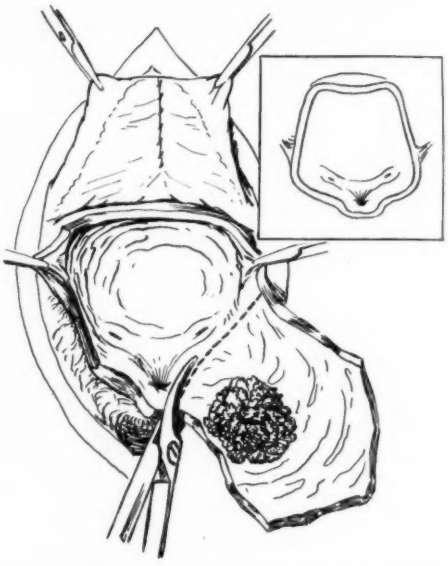
In the stomach, the lymphatics are anatomically separated into three zones: one from the upper two-thirds of the stomach, draining upward to the lesser curvature and the cardia; another, from the lower half of the greater curvature toward the fundus, draining toward the spleen; and a third, from the lower half of the greater curvature, draining toward the pylorus. These systems of lymphatics empty in certain directions. Upon this basis, removal of definite areas of the stomach supplied by a particular zone of lymphatics, as well as the tumor area, must be carried out if permanent cure is to be gained.

The presence of lymphatics in the vesical mucous membrane seems improbable, the supply being an intramuscular one. The emergent vessels of this system terminate in a network on the outer surface of the bladder muscle under the peritoneum or umbilicoprevesical fascia. The course and termination of this network vary according to their situation on the anterior or posterior surface of the bladder.

Anterior surface. From the anterior surface of the bladder there are two groups of connecting trunks. The trunks coming from the inferior segment of the bladder run outward transversely and pass into a gland on the lateral surface of the pelvic cavity, between

[1] Read before the Clinical Congress of American College of Surgeons, Boston, October 23–25, 1922.





Figs. 1 and 2. When the tumor is on the anterior surface, the bladder is bisected laterally and excised down to the internal sphincter.

the external iliac vein and the obturator nerve behind the crural ring. From the superior segment of the anterior surface the trunks run upward and outward, cross the hypogastric artery, and terminate in the middle gland of the middle chain of the external iliac group. Small glands are found along the course of these trunks—called interrupting glandular nodules. Some are in front of the bladder, the prevesical glands; others where the lymphatics cross the hypogastric artery, the laterovesical glands.

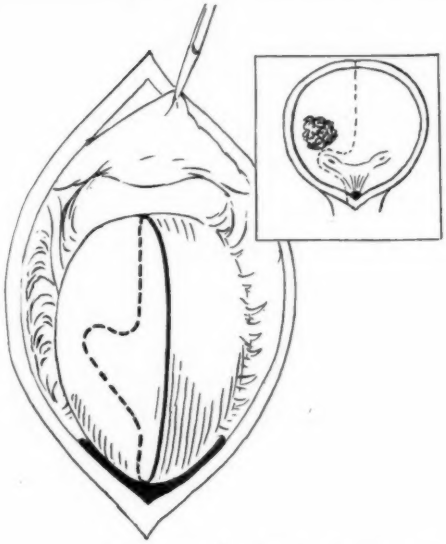
Posterior surface. The posterior surface trunks also form several groups. (a) From the superior portion of the bladder they cross the hypogastric artery and terminate in the external iliac glands with the superior lymphatics of the anterior surface. (b) Other trunks run backward following the hypogastric artery and end in a gland situated on the external iliac vein, in front of the bifurcation of the common iliac artery. (c) Other trunks come from the middle segment of the posterior surface and end in the hypogastric glands. (d) Trunks arising from the inferior posterior surface near the bladder neck, run backward, cross the lateral surfaces of the rectum, ascend on the anterior surface of the sacrum and end in glands situated at the bifurcation of the aorta.

In addition, the prevesical network is continuous with the network which surrounds the prostate, the vesiculæ seminalis, the vasa and the lower end of the ureters. (Poirier-Cuneo-Delamere.)

It would seem that the lymphatic supply is greater in the fundus than in the lower third of the bladder, even taking into account the regression which takes place early in life in the structures of the hypogastric arteries and umbilical cord.

Since the muscular action of the bladder in expelling urine is from above downward, so the drainage of the lymph spaces is toward the inferior bladder segments. Therefore, when operating upon a case of vesical carcinoma, in order to guard against the possibility of lymphatic extension of the disease outside the bladder, the following glandular groups would have to be re-excised:

1. The two middle and external chains of the external iliac group,



Figs. 3, 4 and 5. When the tumor involves the lateral walls, the bisection is made from before backward in the median line and the line of bladder excision made just above the ureteral orifice or as in tumors involving the ureter.

2. The hypogastric glands,
3. The sacral glands,
4. The group of the promontory,
5. The interrupting glands which pass alongside of the bladder fundus, accompany the umbilical artery or come in contact with the vesical neck.

The above extirpation is surgically impossible and thus the conclusion is forced upon us that extirpation of bladder malignancies must be a compromise between the ideal and the possible.

In reviewing a series of 60 cases of vesical carcinoma upon which resections were performed by me or my associates at the Post Graduate Hospital, the locations of the tumors could be grouped into different segments:

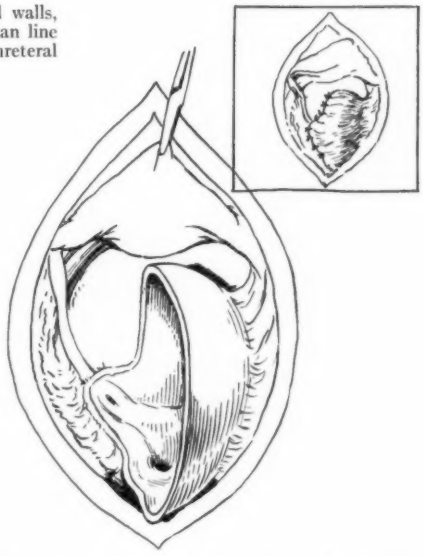
Tumors in the superior fundal segment,

Tumors in the lateral wall segment,

Tumors in the ureteric and post-trigonal segment,

Tumors in the sphincteric segment.

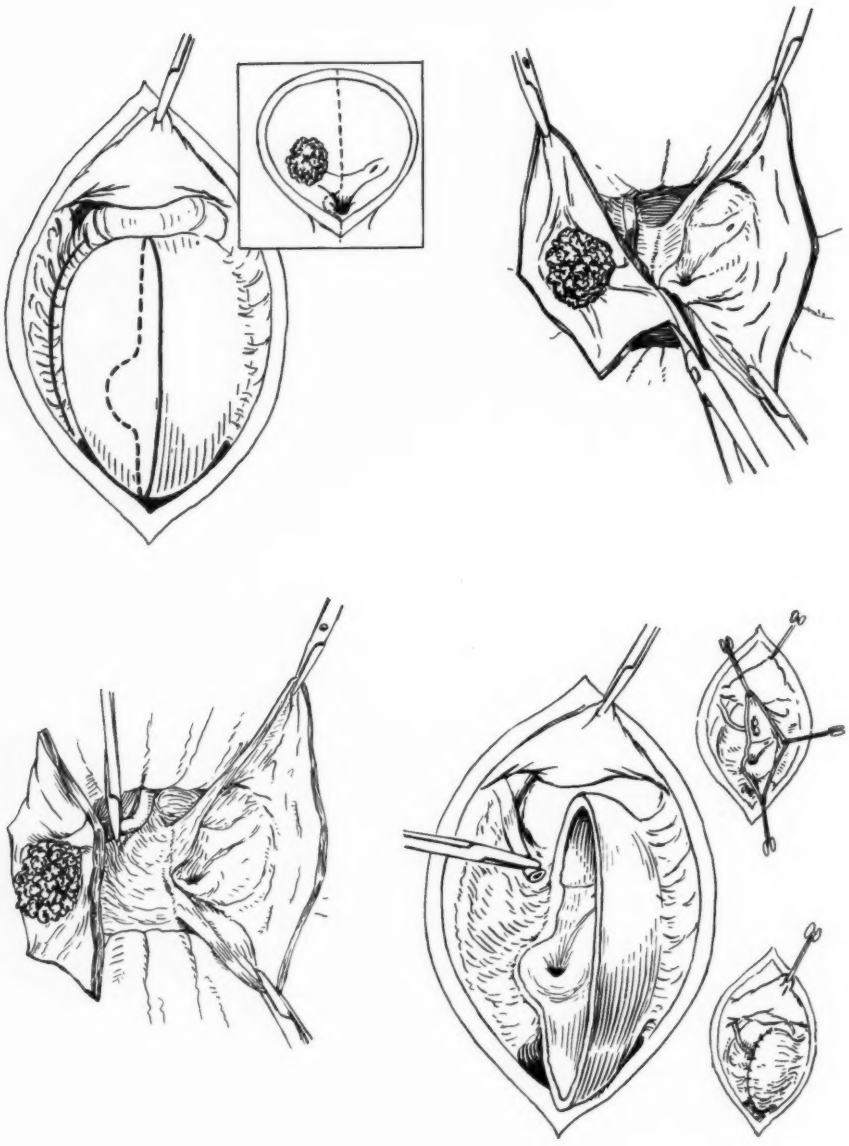
Tumors without the ureteric segment were usually on the fundus or lateral walls of the bladder.



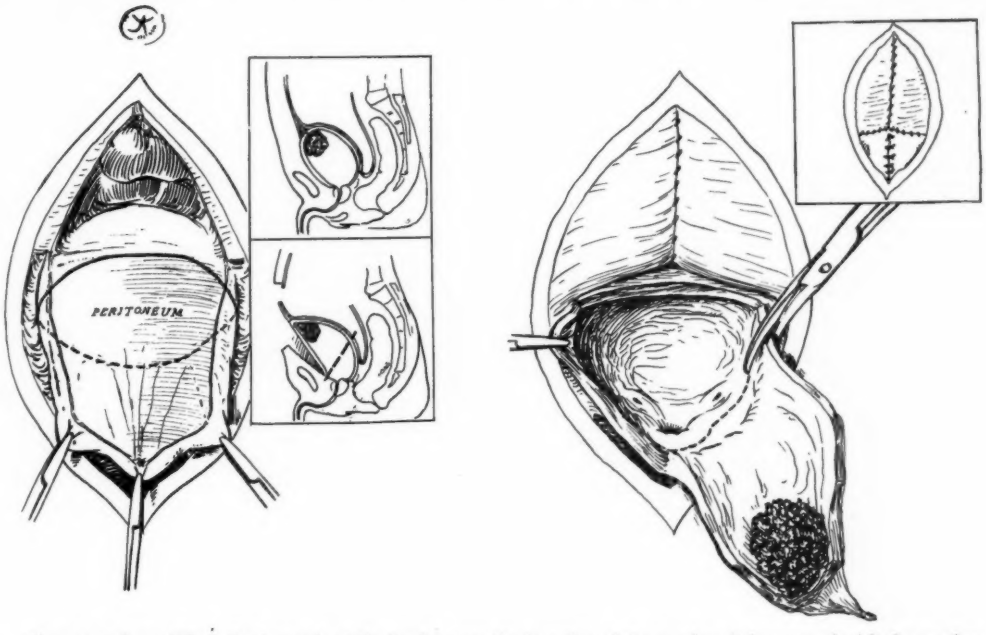
Of the 60 cases referred to, in 9 the tumor was of the fundus on that part of the bladder which had peritoneal covering.

In 31, the tumors occurred in the lateral wall segments without ureteral involvement.

In 20 cases the tumor surrounded the ureteral orifice or involved the trigone near the ureter.



Figs. 6 and 7 (above) and 8 and 9 (below). When the tumor involves the ureteral segment, the bisection is the same but the line of excision is just back of the internal sphincter, with transplantation of the ureter.



Figs. 10 and 11. When the tumor is at the fundus near the insertion of the urachus, it is removed with the urachus and attached adventitious tissue, *en masse*.

Tumors involving the sphincteric segment seem to be secondary to prostatic neoplasm or recurrences of growth primarily located elsewhere in the bladder.

Our experience seems to show that tumors of the superior and lateral wall segments recur more rapidly than tumors of the ureteric segment and that extensive removal of bladder wall toward the base is indicated in tumors in this location. When the growth is in that part of the bladder which is situated just beneath the prevesical space, rapid recurrence is almost an invariable rule. The reason for this is readily understood when one takes into consideration that at this point not only do the lymphatics of the bladder empty into their trunks but are in communication with the network of lymphatics which surround the prostate, vesicles, and vasa.

In several cases when the original tumor occupied the fundus or was high on the lateral walls, recurrences have all taken place in that section of the bladder remaining between the site of tumor and bladder sphincter. Therefore, it is now our custom when operating upon tumors in these locations, to remove bladder wall down to the internal sphincter of the bladder.

When the tumor is on the anterior surface, the bladder is bisected laterally and excised down to the internal sphincter (Figs. 1 and 2).

When the tumor involves the lateral walls, the bisection is made from before backward in the median line and the line of bladder excision made just above the ureteral orifice, or as in tumors involving the ureter (Figs. 3, 4, and 5).

In the growths involving the ureteral segment, the bisection is the same but the line of excision is just back of the internal sphincter, with transplantation of the ureter (Figs. 6, 7, 8, and 9).

Tumors occurring at the fundus near the insertion of the urachus should be removed with urachus and attached adventitious tissue *en masse*, peritoneum, etc., up to the navel (Figs. 10 and 11).

Tumors occurring in that part of the fundus which is covered by peritoneum, should be removed with attached peritoneum.

In this connection it is an interesting observation that early intraperitoneal metastasis is unusual. In only 4 of the 60 cases was this condition present.

Tumors in the ureteric segment should be removed with the ureter end attached and the ureter divided only after the mass has been entirely freed and hangs from the ureter as a pedicle—usually about 2 inches of the ureter with attached fat and fascia must be removed.

The argument for definite segmental resection is based not alone upon the lymphatic supply of the bladder, but because of this tendency for tumors to recur near the internal sphincter. If, for example, the tumor is situated upon the lateral wall of the bladder above the ureteric segment, the course of lymphatic extension would be by way of the trunks draining the superior and inferior segments of the bladder above the trigone. It is my belief, therefore, that all of the bladder wall drained by these systems should be removed with the tumor. This involves an anteroposterior bisection of the bladder with removal of at least one-half of the bladder above the ureteric orifice, and better, the bisection carried to the internal sphincter.

For tumors of the anterior surface of the bladder near the attachment of the urachus, as said before, the bisection is made by lateral incision and the line of excision of bladder is just behind the internal sphincter.

Tumors in this location are prone to recur rapidly, explained probably not only by the more extensive lymphatic supply of the anterior surface of the bladder with the added prevesical plexus of lymphatics, but on account of the greater muscular activity of this part of the organ, cancer cells are squeezed into the lymphatics at an earlier period than in tumors located near the trigone or ureteral orifices.

Be this as it may, it is a clinical observance that those cases in which the original tumor is located upon the anterior aspect of the bladder, although offering the easier operative removal, produce the poorest operative results.

On the other hand, it has been our experience that tumors involving the ureteric segment which necessitate excision of the mural ureter, have given a longer freedom from recurrence and it is among this group of cases that are included our most satisfactory results.

In 1914 I reported an operative technique for the radical extirpation of vesical neoplasms and detailed each step of the operation. Since this, in the main I have followed this technique, but increasing experience has added certain changes which I feel are important.

In this article I advised extirpation of the neoplasms with a wide margin of healthy tissue comprising the entire thickness of bladder wall. Now, as I have already indicated, I believe that the excision should include a segmental resection which in most places will mean a removal of practically one-half of the bladder.

Another change in technique is that, in dealing with tumors which are known to be localized to one lateral wall of the bladder, I do not carry out as extensive a mobilization of the bladder on the opposite side. This seems to have an important bearing upon the reparative period by leaving an undisturbed blood supply of one-half of the organ; lessens the extent of spaces opened up for contamination at time of operation, and minimizes postoperative absorption from these planes.

General statistics are of but relative value, as is illustrated, for example, by the 60 cases referred to in regard to location of tumor site, which were taken from the hospital records from the services of different operators. Many were ward cases and were incompletely followed as to final outcome.

Twenty-seven died during the postoperative period: 24 from shock or uræmia of the progressive cachexia in those in whom it had been impossible to remove the growth; 1 from embolus; 1 from heat stroke, and 1 from suicide.

Twenty-seven were discharged with the comment "improved," at least an operative recovery.

Four were considered cured.

Two were known to return with recurrence.

Some were considered to be operable at the time of cystoscopic examination, only to find at operation that extension existed outside the bladder which could not be outlined by the cystoscope.

Among a series of 75 cases, upon which I have operated by segmental resection and have been able to follow,

Three have lived 8 years without recurrence,
One has lived 7 years without recurrence,
Two have lived 6 years without recurrence,
Four have lived 5 years without recurrence,
Six have lived 4 years without recurrence,
Four have lived 3 years without recurrence,
Eight have lived 2 years without recurrence.

Twenty-seven died in the postoperative hospitalization period, from a variety of causes similar to the other series.

Twenty had recurrences or extensions by metastasis or otherwise, and have died or will do so from this if not other causes.

Twenty-eight are alive after from 2 to 8 years without as yet a recurrence.

STRANGULATED DIAPHRAGMATIC HERNIA OF TRAUMATIC ORIGIN

With Report of a Case[1]

By JERE LAWRENCE CROOK, A.M., M.D., F.A.C.S., Jackson, Tennessee

THE case which furnished the inspiration for this paper consulted us on December 19, 1920, 1 year before the last meeting of this association at which time the operative treatment of the condition was ably presented by a fellow member, Dr. Stone. The subject of "Hernia of the Diaphragm" as suggested by Dr. Stone has received much attention during the last 5 years because of the influence of war wounds in the production of this condition and because of the use of the X-ray in its diagnosis.

In view of the large proportion of cases of traumatic origin, it would not be far-fetched to consider every left-sided gunshot and stab wound of the chest as a potential diaphragmatic hernia. It is easy to understand the mechanics of traumatic hernia of the diaphragm if one considers the features involved in its formation. Of primary importance is the force of aspiration of the thorax which is exerted through the small slit in the diaphragm on the freely movable abdominal viscera. This constant suction due to the negative pressure in the thorax is aided by other factors within the chest. First of all, the omentum enters the opening and prevents union of the edges. This is followed by the formation of adhesions with the thoracic organs, and upon contraction of these adhesions the abdominal organs are dragged upward. In addition, the pleura has a decided tendency to the formation of exudates and the intraperitoneal pressure is increased.

"The stomach and colon are the organs most commonly herniated, the spleen and small intestine being involved less frequently. In many cases the herniated organs are twisted as much as 180 degrees. The severe nutritional disturbances of the colon are easily explained by this incarceration and torsion." These conditions do not prevail on the right side of the chest because of the presence of the compact and plastic liver just beneath the diaphragm which adheres and plugs the rent. Therefore, right-sided diaphragmatic hernia is exceedingly rare.

The case which I shall report presents such unusual features that I shall describe it in detail and follow with a brief review of the recent literature, confining my discussion to "Diaphragmatic Hernia of Traumatic Origin."

J. W. VanC., age 35, residing at Luray, Tennessee, was admitted to the Crook Sanatorium on December 19, 1920, with a history of having suffered 6 days and nights with intestinal obstruction accompanied by persistent vomiting and extreme pain in the left splenic region and also great tenderness over the appendix. The case was described to me over the telephone as "locked bowels" following a case of

[1] Read before the Southern Surgical Association, Memphis, Tennessee, December 13, 1922.

appendicitis. The patient arrived shortly thereafter in a desperate condition. A careful examination of the abdomen showed great distention and tenderness present over the whole area but most marked over the appendiceal region. He stated that his greatest pain had been on the left side underneath the ribs at first but for the past 2 days it had been centered over the appendix and this was the point of greatest tenderness on palpation. He had been treated 2 years previous for an attack of pain and vomiting which was diagnosed as appendicitis. The history of the case and the patient's condition presented features that could not be explained on the theory of appendicitis alone. On account of the history of extreme pain in the left costal region it was decided to give an enema of barium solution in the effort to locate the point of obstruction in the lower bowel. The patient was placed on the X-ray table under the fluoroscope, and with Dr. O. O. Jones, roentgenologist, and Dr. C. F. Webb, my surgical associate, we watched the progress of the barium solution through the rectum and the sigmoid up to the splenic flexure of the colon where it stopped abruptly. We did not wait for further study of the case but prepared the patient for an immediate operation. On account of the tenderness in the right side with a history of appendicitis, together with an evident complete obstruction on the left side, I decided to make a median incision so that I could reach both sides. As soon as the abdomen was opened an enormously distended ascending colon with a distended and highly inflamed appendix appeared. The colon filled the entire field. Before proceeding further the appendix was removed. Then I made a careful examination with my hand, following up the distended colon, and found a slit in the diaphragm through which the entire transverse colon together with the splenic flexure and a large portion of the greater omentum had been sucked up into the chest cavity. We were somewhat prepared to find this condition, as, after the patient was placed on the operating table and just before the incision was made, one of the nurses in raising the patient's shirt exposed an old scar on the left side between the seventh and eighth ribs. This scar was first observed by Dr. Webb who suggested the possible causal relation between this condition and the obstruction. The patient at that time was anæsthetized, and we could not get the history of the scar. With my hand in the abdomen I was able to insert two fingers in the diaphragmatic opening. I attempted to withdraw the incarcerated colon but I found this exceedingly difficult. When I would withdraw a small portion of it, the suction of the chest would draw it back. The enormous distention of the ascending colon completely blocked the field so that it was impossible to see anything and my work had to be done by the sense of touch. I soon found that reduction of the hernia could not be made unless the opening was enlarged. It was impossible to use a knife from below because the distended colon occupied the entire field. I did not like to lose the time necessary to get ready for a thoracotomy as the patient's condition was quite desperate.

I, therefore, decided to divulse the rent in the diaphragm until I could get enough of my hand in to make traction on the incarcerated viscera. This I did very gently and was able to grasp first the transverse colon which I brought down a little at a time, gradually overcoming the suction and adhesions until I had replaced all of the colon in the abdominal cavity. I then followed the same procedure with the omentum. After replacing the bowel and omentum within the abdominal cavity, I found the distention of the entire colon so great that it was impossible to close the incision. I, therefore, placed a purse-string suture in the distended colon, introduced a gall-bladder trocar and cannula through the middle of the area circumscribed by the suture and evacuated sufficient gas and liquid fæces to collapse the bowel. The cannula was carefully withdrawn, the purse-string suture drawn taut as it emerged, the bowel replaced, and the incision closed in the ordinary manner. The patient made an uneventful recovery and left the hospital on the seventeenth day.

During his convalescence he refused to consider a second operation to close the rent in the diaphragm. I insisted on his returning at a later time and allowing me to do this in order that he might escape further trouble, but he would not do so. In response to repeated efforts to get him to come in order that I might examine him as to the advisability of operating to repair the diaphragmatic rent he finally came, December 9, 1922, and we were able to make a roentgenographic examination of him. He also consented to be present at this meeting and I present him to you now. He says he has had no pain nor disability within the 2 years since the operation and apparently is in perfect physical condition today.

A few days after the operation I secured the following history which would have thrown light on the case the night of his arrival but, as stated, the patient's condition was so desperate that we did not take time for a careful history. He stated that 12 years previously he had been stabbed in the left side with a knife; 2 years before coming to me he had pain in his left side followed by vomiting which lasted a day or two and was followed by some obstruction of the bowels. He had had occasional cramps since that time. He had been told that he had chronic appendicitis and so stated the night of the operation. He also stated regarding his present ailment that he was loading a three hundred pound pole of wood, and when he lifted it up and laid it down he felt a keen pain in his left side, but worked on nearly 2 days with his side still hurting him, the pain gradually extending over his entire abdomen. He commenced vomiting 2 days after the pain began and had had no passage from the bowels since the pain started and had vomited until he was brought to the sanatorium.

As stated at the outset this case came to us in December, 1920, one year before the last meeting of this society, and every quotation from the literature used in this paper comes from papers printed in 1920, 1921, 1922, which, of course, were not available when I operated on this patient. The case has led me far afield into a most interesting study of the recent literature, and the surgical technique of operators in America, Germany, France, and England has been compared.

P. E. Truesdale[1] in the *Journal of the American Medical Association*, 1921, outlined the literary history of this subject from 1610, when the first two cases were reported by Paré, to 1853, when a monograph by Bowditch appeared. This latter author compiled 88 cases, comprising all cases in the literature up to September, 1921, since which time about 43 cases from battle wounds had been added to the literature by the recent war. The same author,[2] in the *Annals of Surgery*, in 1921, in discussing the frequency of operation for diaphragmatic hernia reports that Scudder found 53 cases recorded up to 1911, and Frank in 1919 could add only 41 additional cases. From 1918 to 1920, inclusive, 96 cases have been reported. Of the 96 cases collected 43 were the results of battle casualties, and he adds that the rapid increase in the number of operations for this condition is manifest, while there is no doubt that the number of cases treated and not reported is considerable. He states that intestinal obstruction is the outstanding factor of risk to life. In Scudder's series the surgical mortality was 75 per cent, essentially because of intervention during strangulation of the transposed viscera. Unlike this accident in other types of hernia the process is concealed and the symptoms and physical signs somewhat strange. Hence delay is the rule and the mortality exceedingly high. The operation mortality depends upon the number of cases encountered during acute intestinal obstruction. Warren reported 8 cases treated surgically during 10 years at the London Hospital. Only one lived. Seven were operated upon in the presence of acute obstruction. The general mortality after operation in the non-strangulated type averages 10 per cent.

Truesdale favors the thoracic approach to the diaphragm for the surgical treatment of diaphragmatic hernias. He says that the majority of American and British surgeons have preferred the abdominal approach, but that the French prefer the thoracic operation. But, of course, no one plan of approach is best suited to all cases. French surgeons also have used a third method which combined the thoracic and abdominal approach, and has been termed a "thoracolaparo-chondro-phrenotomy."

In connection with other statistics on diaphragmatic hernia, R. P. Rolands,[3] in *Guy's Hospital Report*, reports that Marshall Lloyd found only two cases recorded in the surgical reports of Guy's Hospital between 1866 and 1920. Both were due to crushing, and the patients died shortly after admission to the hospital without an operation. Out of 433 cases analyzed by Grosser and Thoma, 232 were congenital and 181 acquired, "but it is often very difficult to settle this point."

In comparing the abdominal and thoracic operations the author states "in 52 traumatic cases without strangulation, analyzed by Binnie, the mortality for the thoracic route was only 9.6 per cent, compared with 50 per cent for the abdominal route; in cases with strangulation the mortality was 50 per cent for the thoracic route and 100 per cent for the abdominal (Neugebauer). Scudder analyzed 55 operations: 11 thoracic with 7 recoveries; and 42 abdominal with 7 recoveries. It is possible, however, that the abdominal route was adopted in the most severe cases on account of signs of associated injuries in the abdomen."

D. L. Borden writes in a recent article (1922) that up to the beginning of the Great War, 650 cases of diaphragmatic hernia had been reported in the literature, and that only 15 of this number had been diagnosed before operation or autopsy, but that the roentgen-ray has demonstrated with great efficiency this pathological condition without waiting for operation. Since the onset of the war an increasing number of cases has been re-

[1] Truesdale, P. E. J. Am. M. Ass., 1921, lxxvii, 993-998.
[2] Truesdale, P. E. Ann. Surg., 1921, lxxiv, 347.
[3] Rolands, R. P. Guy's Hosp. Rep., 1921, lxxi, 91-101.

ported. Borden adds that a recent communication from the Mayo Clinic states that no cases of diaphragmatic hernia have been observed in their hospital since those reported in 1916 by the late Dr. Beekman, and he reported only 3 cases, 1 seen in 1909, 1 in 1911, and 1 in 1916.

Borden says regarding treatment: "Unquestionably the abdominal route is the one of choice." But he adds: "When adhesions prevent the reduction of the hernia from below, a thoracotomy, though adding to the operative risk, may be necessary to enable the operator to free the hernia from above and restore its contents to the abdominal cavity. When a traumatic opening exists in the chest, as in some wounds or other cases, the hernia may be repaired through it from above."

E. C. Roos in a recent (1921) paper says that there are two methods of surgical treatment of these hernias, the transpleural and the transperitoneal, and that the former is perhaps the better method as it permits a better exposure and a freer manipulation of the hernial contents, and also allows a better closure of the hernial openings. Further, with the present method of producing anæsthesia in thoracic surgery, this method is gaining in favor.

He also says that if the transperitoneal route is used, the various steps necessary in treatment have to be carried out at a great depth and more or less blindly, although a better approach may be obtained by a resection of the costal arch.

After a careful search of the literature following Truesdale's paper which appeared September 24, 1921,[1] I have been able to collect 13 additional cases of frank traumatic origin including the one reported by Dr. Stone last year, which occurred in March, 1918.

On the two sides of the important question of surgical technique a study of the literature showed the following advocating the thoracic approach: C. B. Keenan, G. Cotte, M. B. Gordon, D. L. Golann, Sauerbruch-Schumacher in early cases, R. P. Rolands, Llobet, Cranwell, Carson, and Barton. Rolands states that very few recoveries have followed operation, especially when the abdominal route has been adopted.

The following advocate the abdominal approach: S. Barling, A. D. Bevan, Dehelly, W. H. Holmes, L. F. Huffman, A. E. Keown, F. S. Matthews, H. M. Imboden, Nieden, Reichel, T. F. Riggs, Balfour, H. E. Waxman, and O. Orth, the last named advising abdominal approach when ileus predominates.

Garre prefers the abdominal approach in simple cases, and, in advanced cases with suspected gangrene, the thoracic approach; L. Prat, Sauerbruch, and Truesdale report thoracic approach in one case and abdominal approach in another case.

From the foregoing it will be seen that there is a wide divergence of opinion as to the relative merits of approach. I believe the condition of the patient at the time he is first seen should determine largely our decision in this important matter. Where symptoms of strangulation and ileus are apparent, the abdominal approach is an absolute necessity. Where the case is a chronic one and the diagnosis has been clearly established and confirmed by X-ray before operation, I believe the combined approach is indicated. From the experience gained in the case herein reported I feel that every preparation for the double operation should be made in advance provided the diagnosis has been made in advance. The abdominal incision should be made first and if reduction can be successfully performed and access can be had to the rent in the diaphragm it might not be necessary to open the chest.

In the case reported had I been able to diagnose the condition in advance, the chest could have been prepared, the proper instruments assembled, and when it was evident that the suture of the torn diaphragm could not be done from below a rapid thoracotomy would have made it possible to repair the rent. In this event an assistant with his hand in the abdomen can be of vast benefit to the operator by controlling the viscera and elevating the diaphragm from below while the operator works from above through the thoracic incision. However, I do not believe my patient would have survived had I undertaken a thoracotomy to suture the diaphragm after

[1] J. Am. M. Ass., 1921, Sept. 24.

relieving the obstruction. He was dying from intestinal obstruction and I operated to save his life by relieving the obstruction. He recovered because the operator preferred an incomplete operation and a live patient to a technically perfect surgical feat and a fatal result.

I wish to add to my own paper the following recently reported cases which are typical examples of traumatic hernia of the diaphragm:

C. B. Keenan in Ann. Surg., 1922, lxxv, 625, reports two interesting cases, both of which were successfully operated on by the thoracic approach.

Nieden in Muenchen. med. Wchnschr., 1920, lxvii, 1188, reports a case of strangulated hernia with complete retention of fæces for 1 week, the patient having been run over 1 year before present illness began. He did a laparotomy with median incision and after replacing the herniated transverse and descending colon, spleen, and greater omentum, he sutured the rent in the diaphragm from below. After the operation was completed severe symptoms of pneumothorax set in but disappeared when thoracotomy was performed.

A case which is strikingly similar to mine was reported by H. E. Waxman, in J. Am. M. Ass., 1922, lxxix, 123–124. It occurred several years after a bullet wound of the chest, and was strangulated, causing intestinal obstruction. It involved the splenic flexure of the colon and was complicated with acute appendicitis. The appendix was removed and the hernia reduced through the same incision. In his case the result was fatal.

CONCLUSIONS

Our fellow member, Dr. H. B. Stone, at the meeting of this association last year, in his judicial discussion of the question of approach seems to me to have fairly presented the subject from both angles. I believe his conclusions are sound and deserve restatement and emphasis:

"1. Abdominal exploration is essential in the great majority of cases of diaphragmatic hernia.

"2. Thoracic approach greatly facilitates the necessary operative steps.

"3. The method of choice, therefore, for the routine handling of these cases should be by combined abdominal and thoracic incisions.

"4. These incisions are best made separately instead of by the French method of a continuous incision."

I wish to add a fifth conclusion:

5. The X-ray is a positive means of diagnosis in this condition and its use should never be omitted.

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FRACTURES OF THE FIFTH METATARSAL[1]

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WHILE the fifth metatarsal bone is less frequently broken than the other metatarsals, yet its attachments and configuration undoubtedly make it perhaps most frequently the seat of fractures by indirect violence. Nion (1) collected 233 cases of metatarsal fractures and found that of these 112 were of the second, 98 of the third, 17 of the fourth, and but 6 of the fifth. Piersol (2) states that of the metatarsal bones, the first, although the strongest, is most frequently broken because it carries so large a proportion of the body weight and because it receives an undue share of the violence in falls associated with eversion of the foot. He contends, moreover, that the fifth comes next in frequency because of its exposed position on the outer side of the foot and the added violence in cases of inversion.

Prior to 1902, textbooks taught that *all* metatarsal fractures were produced by direct violence. In that year Sir Robert Jones himself sustained a fracture of the fifth metatarsal which occurred while he was "dancing somewhat vigorously" and his paper brought out the fact that fifth metatarsal fractures by indirect violence are of rather common occurrence. In 1905, Lilienfeld (3) analyzed 600 fractures and found that among them there were five fractures of the tuberosity of the fifth metatarsal and of these, three were by indirect violence, and two were by direct. Of some interest in this connection may be mentioned that he also discovered in this series seven fractures of the posterior tubercle of the astragalus and of these five were associated with a fracture of the calcaneus.

In 1908, Wharton (4) reported 3 cases of fracture of the proximal end of the fifth metatarsal by indirect violence. The patients were 45 years, 10 years, and 10 years, respectively, and they were satisfactorily treated by immobilization in plaster-of-Paris for 2 weeks.

The fifth metatarsal is a short, sturdy bone consisting of a base, a shaft, and a head. The base is very oblique and its inner two-thirds bears a facet for articulation with the cuboid. The outer part of the base is prolonged as the tuberosity beyond the edge of the foot, overhanging the joint. The inner side has a facet for the fourth metatarsal bone. The head, like the shaft, is compressed from side to side, and it has a pair of lateral tubercles at the dorsal aspect of the end of the shaft which are separated by a groove from the articular surface. Lateral ligaments are attached both to the tubercles and the grooves. The articular surface at the head is oblong and extends well onto the plantar surface.

Of particular interest in fractures of the fifth metatarsal, especially those by indirect violence, is the anatomy of the base of the fifth metatarsal. (See Fig. 7.) In the first place the marked protrusion of the tuberosity beyond the lateral line of the shaft and the lateral border of the anterior two-thirds of the foot make it particularly exposed to external violence which is directed toward the side of the foot. In consideration of the etiology of fractures of the tuberosity of the fifth metatarsal by indirect violence, the number of structures attached to it is very significant. First, there is inserted, on the dorsal aspect, the peroneus brevis muscle. This muscle arises from the lower portion of the lateral surface of the fibula and from the intermuscular septa. Its fibers join a tendon which passes behind the external malleolus. Its action is to extend and evert the foot. Second, there is inserted in the plantar lateral aspect of the tuberosity a portion of the abductor digiti quinti muscle which arises from the under surface of the calcaneum and from the plantar aponeurosis and the action of which is to abduct and flex the little toe. Third, the outer portion of plantar fascia is a strong band running from the tuberosity of

[1] Read before Chicago Surgical Society, March 2, 1923.

Fig. 1. Case 2. Patient twisted ankle when struck by an automobile. Probably a fracture by indirect violence.

Fig. 2. Case 3. Patient struck by an automobile and knocked down. The front wheel ran over the *internal* aspect of the ankle. Probably indirect violence.

the os calcis to the tuberosity of the fifth metatarsal (5). Fourth, the abductor ossis metatarsi quinti is a muscle which is occasionally present and runs from the os calcis to the tuberosity of the fifth metatarsal. Fifth, the flexor brevis minimi digit muscle arises from the inferior surface of the tuberosity of the fifth metatarsal and is inserted by a tendon into the outer surface of the base of the first phalanx of the fifth toe and also into the distal portion of the fifth metatarsal.

Moreover, of less interest to the fractures of the tuberosity perhaps than to those of the base as a whole are the following structures: first, the peroneus tertius muscle which arises from the fibula and interosseous membrane, and the tendon of which after passing through the lateral compartment of the anterior annular ligament is inserted in the anterior surface of the base of the fifth metatarsal bone. Second, the ligamentous bands which run from the cuboid to the fifth metatarsal, and third, the part of the plantar calcaneo-cuboid ligament which runs from the cuboid to the base of the fifth metatarsal.

To the shaft of the fifth metatarsal are attached, first, the third plantar interosseus muscle and, second, the first dorsal interosseus muscle.

In discussing the mechanism of fractures of the base of the fifth metatarsal, Sir Robert

Fig. 3. Case 4. Patient's foot subjected to a severe squeeze. Direct violence.

Fig. 4. Case 5. Patient struck by the fender of a cab and thrown violently to the pavement. Probably a fracture by indirect violence.

Fig. 5. Patient C. C. (St. Luke's Hospital No. 161861. Dr. Albert E. Halstead.) Foot run over by the wheel of an automobile. Direct violence.

Fig. 6. Case 6. Patient stepped down off of a step ladder and violently twisted her foot. Fracture of the distal extremity of the fifth metatarsal by indirect violence.

Jones (6) says that it is a cross breaking strain directed anteriorly to the metatarsal base, and caused by body pressure on an inverted foot while the heel "is raised." The prominent base of the fifth metatarsal is closely bound to the cuboid and to the fourth metatarsal by strong ligaments on every side. Jones contends that these ligaments are so strong that dislocation of the base is the rarest of accidents and that it is easier to break the bone than to dislocate it. When the heel, therefore, is off the ground, the body weight expends itself upon the fifth metatarsal, rotating it slightly inward. The opposition to this force takes place at its base where the strongly attached ligaments resist its displacement.

The frequency with which the tuberosity alone is broken cannot but attract attention to the structures attached to it. To it are attached the peroneus brevis, the abductor digiti quinti, the outer portion of the plantar fascia, the flexor brevis minimi digiti, and, occasionally, the abductor ossis metatarsi quinti. All these structures are strongly stretched by a sudden inversion of the foot particularly with the heel off the ground, and it is not to be wondered at that the tuberosity, their common attachment, is torn loose.

Fractures of the base of the fifth metatarsal or of the tuberosity alone are undoubtedly very common, but their recognition is not always easy, and they are frequently diagnosed as a sprained ankle and the convalescence is troublesome and prolonged. Mock (7) reports a case which came to him in his first year of private practice. The patient had twisted his foot jumping out of bed. A diagnosis of sprained ankle was made but another surgeon, by means of the X-ray, found a transverse fracture just below the tuberosity of the fifth metatarsal.

In making a diagnosis, the history of a twist of the ankle—a sudden inversion—is of importance. Not infrequently the patient is in an automobile accident and may ascribe his foot injury to some part of the automobile striking his foot. It is probable that in the effort to avoid the automobile that the patient violently twists his ankle and thus causes a fracture by indirect violence. There is generally no crepitus, no deformity, no yielding on manipulation. There is a tender point at the base of the fifth metatarsal and when the patient attempts to flex his toes or attempts to invert the ankle there is pain.

The treatment is generally simple. Immobilization in a plaster cast for 2 to 3 weeks, this to be followed by baking, massage, and cautious use. Operative interference may be demanded. Young (4) reports a case in which union did not occur and removal of the distal end of the first, the fifth, and then the fourth metatarsal was employed.

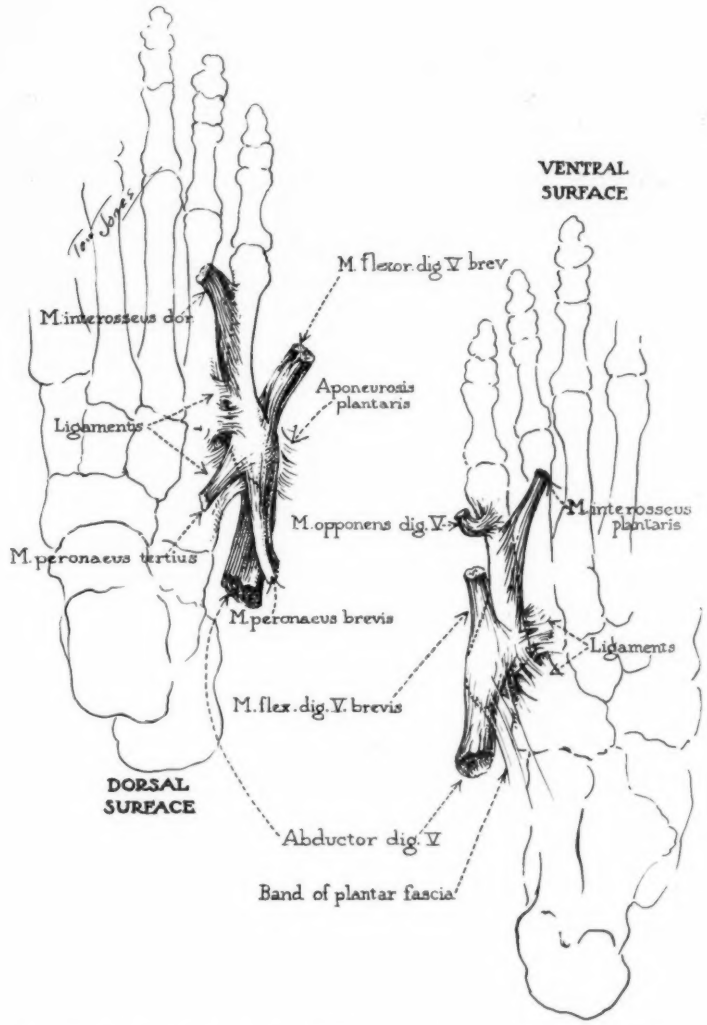

Fig. 7. Drawing showing anatomy of fifth metatarsal—ventral and dorsal surfaces.

The following cases are good illustrations of the condition.

CASE 1. Mrs. E. (author's case), a stout woman of some 45 years turned ankle suddenly and experienced a sudden severe pain. X-ray showed a fracture at the base of the fifth metatarsal. Treatment plaster cast for 10 days.

CASE 2. P. T. (case of Dr. Harry Mock, St. Luke's Hospital). Patient twisted ankle when struck by automobile and sustained a fracture of the fifth metatarsal, probably by indirect violence although patient's shoe was torn.

CASE 3. J. D., male, age 56 (case of Dr. Albert E. Halstead, St. Luke's Hospital No. 147574). Patient was knocked down by automobile and wheel ran over *inner side* of ankle. This seems undoubtedly to have been a fracture of the fifth metatarsal by indirect violence. Treated by a cast.

CASE 4. K. W., male, age 35 (case of Dr. L. L. McArthur, St. Luke's Hospital No. 151031). The machine the patient was driving was struck by a

freight train and the patient's left foot was pinched between the coupling on the car and the clutch pedal of his automobile. This may have been a fracture by direct violence.

CASE 5. J. S., female, age 54 (case of Dr. Albert E. Halstead, St. Luke's Hospital No. 149092). Patient struck by the fender of a cab and thrown violently to the pavement. In this case the fracture was undoubtedly one by indirect violence as it is unlikely that the fender could strike the patient's foot.

CASE 6. Mrs. P. (author's case). Patient twisted foot in falling from the first step of a step ladder. In this case there was a linear fracture in the center of the distal extremity of the shaft of the fifth metatarsal. The explanation of this fracture might be the sudden pull of the third plantar interosseous upon the mesial side of the shaft of the bone.

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PAPILLOMA OF POSTERIOR URETHRA—THE CAUSE OF PROFUSE HÆMORRHAGE AND URINARY RETENTION

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PAPILLOMATOUS or polypoid tumors of the urethra are not exceedingly rare. The following case, however, presents features of interest in view of the quite unusual character and the severity of the symptoms, and on account of diagnostic difficulties encountered. A very small pedunculated tumor of this type, located in the prostatic urethra, was in this case responsible not only for retention of urine, but also caused bleeding so profuse in amount as twice to require evacuation of clots from the bladder through a suprapubic incision. It is of further interest to note that the blood regurgitated into the bladder, and was not voided through the urethra.

CASE REPORT

History. The patient, male, aged 50, with a negative past history, dated onset of present illness to November, 1917, with an attack of acute retention of urine, occurring without apparent cause and requiring catheterization. During the succeeding four years patient noted urinary difficulty, characterized by periods of frequent urination associated with straining and dribbling. There was no blood observed. No urological examination was made during this period.

In February, 1921, there occurred a sudden and profuse urinary hæmorrhage, accompanied by retention of urine and distention of the bladder with blood clots. Catheters and metal instruments were passed easily into the bladder, but on account of the large amount of firmly clotted blood it was not possible to relieve the patient by aspiration.

Suprapubic cystostomy, February, 1921. As an emergency procedure, the bladder was opened through a suprapubic incision by Dr. Donald Macrae, and a large amount of thick, firm clot evacuated. The most minute inspection at this time revealed merely a normal bladder mucosa. There was no apparent source of bleeding, nor was blood seen coming from either ureteral orifice.

Postoperative history. The patient's immediate convalescence was uneventful. There was no further bleeding. The suprapubic fistula, however, continued to drain, in spite of two operative attempts at closure, and in spite of a retained urethral catheter. When seen 8 months after operation, he was able to pass approximately half of the urine through the urethra, with considerable difficulty.

General physical examination at this time was negative. Rectal examination was negative. Cystoscopy revealed nothing further than chronic inflammatory changes in the bladder. Examination of the posterior urethra with an endoscope was likewise negative. The patient became dissatisfied and left the hospital with suprapubic fistula persistent and without a diagnosis.

In February, 1922, one year after operation, profuse hæmaturia suddenly recurred, again distending the bladder with clots. As on the former similar occasion, although it was easily possible to pass instruments into the bladder, efforts to relieve the patient by aspiration of the blood clots were unsuccessful. There was, therefore, no recourse but suprapubic incision.

Second suprapubic cystostomy, February, 1922. The bladder formed a firm, tense, visible tumor, extending to the level of the umbilicus. Incision revealed several ounces of bloody urine, and an enormous quantity of firm, thick clot, which was removed by the handful. As on the previous occasion, the most deliberate inspection, with a good exposure and light, revealed no papilloma or other source of bleeding.

Second postoperative history. Again the bleeding ceased while the suprapubic fistula and the urinary difficulty persisted. Cystoscopy, ureteral catheterization, functional kidney test and bilateral pyelogram, 2 months after operation, revealed a normal kidney on either side. A second urethroscopy was likewise negative.

A review of the history at this time, and a consideration of the two outstanding symptoms (profuse recurrent hæmaturia and urinary obstruction), in spite of the preceding negative urethral examinations, compelled the diagnosis of urethral tumor. This opinion was dependent also upon the normal bladder and the unobstructed urethra. A third urethroscopy, under a general anæsthetic, was accordingly undertaken.

Urethroscopy, March, 1922. The internal vesical sphincter was seen to close normally. Verumontanum was normal. Walls of prostatic urethra were normal, except for chronic inflammatory changes. The endoscope (Buerger cysto-urethroscope) was slowly withdrawn a distance that seemed to be about 2 centimeters beyond the verumontanum, when the pedunculated polypoid tumor shown in Figure 1 suddenly sprang into view. It was quite apparent that the tumor had been bent down by the withdrawal of the instrument, and consequently excluded from view until released by extreme withdrawal. This explained the previous negative urethroscopic examinations. The pedicle was attached to the inferior left aspect of the urethral mucosa, in about the 4 o'clock position. The tip was bulbous, and its surface very dark red and slightly lobulated, like the surface of a raspberry. Size of the bulbous tip was approximately that of the verumontanum. In the semi-transparent pedicle, blood vessels were visible. The point of origin of the pedicle was really membranous rather than prostatic urethra, because just after this point was passed, the characteristic "jump" was felt as the end of the instrument slipped through the opening in the triangular ligament, obscuring the tumor from view.

Fulguration. The tumor was destroyed by means of a fulguration electrode used through a cysto-urethroscope. Unfortunately no tissue was obtained for microscopical examination.

Subsequent history. The patient felt an immediate relief from urinary obstruction, and was able to pass a normal-sized stream without difficulty for the first time in 4 years. Slight suprapubic leakage persisted intermittently for a period of 3 months. Patient gained in weight and remained well while under observation (a period of 8 months).

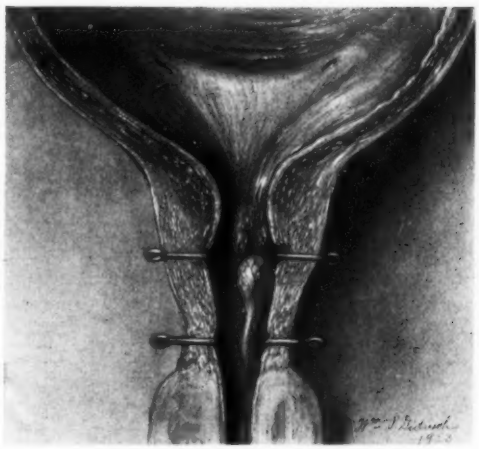

Fig. 1. Pedunculated, bulbous-tipped papilloma, springing from the urethral mucosa at the junction of prostatic and membranous portions.

PATHOLOGY

The literature pertaining to new-growths of the male urethra contains the most varied descriptive terminology, based mainly upon the gross appearance and not upon the microscopical pathology of these tumors. There are authentic reports describing cases of true carcinoma, sarcoma, adenoma (1), angioma (2), and fibroma (3), of the urethra. Randall (4) cites 25 cases of carcinoma and 10 cases of sarcoma. Our particular interest, however, lies with none of these but with that group of benign new-growths, more or less pedunculated, which have a superficial attachment to the urethral mucosa, which project into the urethral lumen, and which may be loosely described as being polypoid or papillomatous in type. Among others, are to be found the terms excrescence, vegetation, granulation tissue, caruncle, condyloma, urethral wart, papilloma and polyp, referring to these benign new-growths. Randall has given the classification of these tumors the most thorough consideration. After a microscopical study of specimens removed from fourteen cases, he has divided tumors of this type into three groups, as follows: (1) benign fibrous polyps, made up of loose fibrous tissue covered with normal urethral epithelium, and analogous to mucous polyps found elsewhere in the

body; (2) benign villous polyps, in which the epithelium shows papillary outgrowths; (3) benign glandular polyps, showing enclosed glandular acini.

It is difficult to draw a distinction between papillary projections of the urethral mucosa which are primarily neoplastic in origin, and those which are secondary to, or are associated with, chronic inflammatory changes in the posterior urethra. Those of the latter type are apt to be multiple in number and minute in size. A recent study by Player and Mathe (5) lays emphasis upon the inflammatory changes made out in microscopical section in all of a series of eight cases. These authors describe this type of tumor as being made up of either fibrous or glandular tissue, with an infiltration of small round cells and polymorphonuclears. Their classification is as follows: (1) true polypi with pedunculated bases; (2) polypoid masses with sessile bases; (3) simple œdematous excrescences.

DIAGNOSIS

Since the above case is quite unique with respect to symptomatology, it is of interest briefly to consider this subject. The vast majority of these patients have a history of gonorrhœa, and present symptoms of an irritative lesion of the posterior urethra—namely, chronic urethral discharge, urinary disorders (frequency and burning), referred pains which may be exceedingly varied in character, and sexual disorders. Profuse hæmaturia and mechanical urinary obstruction are among the rarer symptoms. In Randall's series of 14 cases there was only 1 case of hæmaturia, and none showed urinary retention. The cases reported by Player and Mathe included no case of either hæmaturia or retention.

It has been possible to collect five isolated cases somewhat similar to the one above reported, but in none of these has there been a history of a bladder distended by regurgitated blood. In 1891, Goldenberg (6) reported a case of urinary retention in a man of 59, relieved by removal of a polypoid "growth the size and shape of a split bean, attached by a broad pedicle to the upper and left wall of the urethra, near the bulb." Bryant's (7) case, a man aged 62, had both retention of urine and profuse hæmaturia. A cure was effected by the perineal operative removal of "a polypus the size of a haricot bean—attached to the floor of the (prostatic) urethra." Morrow (8) described multiple polypoid growths filling the bulbous urethra for a distance of an inch and a half, and removed by means of an endoscopic snare. Here also there was profuse urethral bleeding and there were obstructive symptoms. Marion's (9) case was one of complete urinary retention dating back over a period of several years. Cystoscopy and rectal examination were negative. After suprapubic removal of a small prostate, a large papillomatous growth, attached to the mucosa of the prostatic urethra, was found upon examination of the removed specimen. Culver's (10) patient, a man of 56, gave a history of urinary retention, not relieved following suprapubic prostatectomy. The fistula remained patent until subsequent examination revealed multiple papillary tumors of the posterior urethra, the largest attached to the verumontanum. Recovery followed removal by snare and fulguration.

These 5 cases from the literature of urethral tumor producing urinary obstruction, together with the 1 herewith presented, have several diagnostic features in common. In each, rectal examination was negative, as was cystoscopic examination, and in none did the urethra obstruct the passage of a soft rubber catheter. Hæmaturia, added to the above evidence may be considered almost pathognomonic, and under these circumstances negative endoscopy should be repeated.

TREATMENT

In treating these cases various methods have been used, including open operation, snare, and caustic application. Goldenberg reports having sliced off the pedicle of the tumor with the edge of the endoscope. Randall used rongeur forceps and applied silver nitrate to the base with good results. The method latest advocated, and probably the simplest and the most efficient, particularly for the smaller tumors of this type, is the use of the fulguration electrode. The chief objection to the latter method is that the specimen is destroyed for microcsopical examination.

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CONGENITAL RECTAL STRICTURE AS THE CAUSE OF INFANTILE MEGACOLON[1]

BY VERNON C. DAVID, M.D., CHICAGO

HIRSCHSPRUNG described congenital idiopathic megacolon in 1886 and reported the history of several cases he had examined. Since that time, the condition has been generally known in literature as Hirschsprung's disease. Many doubts have been expressed, however, as to the idiopathic character of the disease and the question raised as to the importance of other congenital malformations in the gastro-intestinal tract, producing partial obstruction of the colon and acting as the cause of the megacolon. Hirschsprung, as well as Concetti, who later reviewed the subject, were well aware of this possibility and laid down as a premise that the cases of megacolon they were describing had no obstruction of the large bowel as a causative factor.

Hirschsprung's disease, as described by Hirschsprung, Concetti, and Neugebauer, has been characterized by dilatation of the sigmoid alone, in most of the cases reported. Next in frequency of involvement has been all of the colon except the rectum and then all of the colon including the rectum. The transverse colon or rectum has been affected alone in rare instances. In the forme condulante of Hirschsprung, a normal sized portion of bowel is present between the two markedly dilated portions. The cæcum, contrary to cases with obstruction of the bowel, is not ballooned out nor is the small bowel distended. The circumference of the affected sigmoid may be very greatly increased, reaching as much as 70 centimeters in circumference in one case reported. The thickness of the bowel musculature is not increased (Hirschsprung) as in obstruction of the bowel. Neugebauer, however, believes that the thickness of the muscularis is practically always increased, but cases have been reported where the bowel wall was so thin as to be transparent. There is a decided lengthening of the large bowel affected so that several loops of sigmoid may be formed. Biermans reported a transverse colon twice as long as normal and the sigmoid has been measured 78 centimeters in length in a child with Hirschsprung's disease. Contained in the distended loops of bowel are large accumulations of gas and fæces. In the impacted fæces, sandy particles of phosphates and fatty acids are found. Forty-seven pounds of fæces have been removed from a dilated colon which formed a tumor reaching from the symphysis to the ensiform cartilage. The dilated sigmoid is commonly found in the midline or to the right in contrast to its normal position. The haustral markings of the sigmoid are commonly lost and the folds of mucosa flattened. Pigmentation of the mucosa may be present and occasionally ulceration from pressure of

[1] Read before the Chicago Surgical Society February 3, 1923. (For discussion see p. 239.)

Fig. 1.

fæcal masses develops. Microscopic examination of the affected bowel wall reveals normal musculature, nerves, and blood vessels. Other viscera undergo changes consequent to the presence of a large abdominal tumor. The bladder is often enlarged, the liver is pushed to the right, the diaphragm is elevated. Disturbance of circulation from pressure on the vena cava and hydronephrosis from pressure on the ureter have been described.

Other theories of cause of megacolon. While Hirschsprung described the condition of congenital idiopathic megacolon, other authors (Marfan) have advanced the theory that the congenital defect consisted of an increased number of loops of colon and that distention of these loops to form a megacolon was due to rotation or angulation of these full loops with a consequent chronic obstruction of the bowel. In Neugebauer's collected cases, seventeen instances where volvulus had occurred were cited.

A kinking of the bowel may cause partial obstruction and at the site of the angulation a valve of mucosa may form. Such a condition was described in the literature by Jacobi as far back as 1868. This angulation usually occurs where the movable sigmoid passes over the promontory of the sacrum to become the rectum. At the rectosigmoidal junction, a normal physiological narrowing occurs as was described by Amussat, and a reduplication of the mucosa may frequently form a valve-like fold. This is exaggerated when the loaded sigmoid angulates at this fixed point (Laewen). This view obviously inclines to the belief that a mechanical hindrance to the fæcal stream is an essential etiological factor. Konjetzny reports the postmortem findings in a three-day-old baby with a large colon which he hardened in formalin by injecting the formalin into the blood vessels of the bowel. On examination of the specimen, he found transverse plications at the rectal valves of Houston and at the rectosigmoidal junction which prevented the flow of water from the sigmoid into the rectum. Plantogena reported a similar case which died 4 weeks after birth and which presented a similar valve at the rectosigmoid which prevented the flow of water from the sigmoid into the rectum.

Other mechanical causes have been reported, such as a spasm of the anal sphincter with or without fissure *in ano* (Fenwick-Wilms). While this condition may play a rôle in a few cases, it is not found commonly in children with a megacolon.

Another case was reported in which congenital angioma of the rectum was the factor causing the obstruction.

Insufficient innervation of the bowel has been mentioned as a cause but histological study and clinical observation do not bear this out.

Aplasia of the muscularis of the bowel is sometimes present but is probably secondary to pressure of the accumulated fæces and gas.

Diastasis of the recti muscles, chronic constipation, and dietary errors are contributing causes which may have a considerable bearing on the development of a megacolon. It hardly seems possible that these factors are the underlying causes in most cases.

Neugebauer has classified infantile megacolon as follows:

I. Congenital idiopathic megacolon (gigantism of the colon, Hirschsprung's disease);
II. Acquired megacolon—
    1. Congenital increase in length of colon by reason of excessive loop formation;

Fig. 2.

Fig. 3.

2. Rectal valve hypertrophy;
3. Spasm of the sphincters or bowel muscles.

To this classification should be added congenital stricture of the rectum as a causative factor in acquired megacolon.

The following cases are illustrative:

CASE 1. Female, F. M., age 16 months, entered the Presbyterian Hospital on the service of Dr. Walter F. Winholt. The patient's complaints on entering the hospital were (1) heart trouble, (2) failure to gain, and (3) distended abdomen. Since birth the abdomen had been distended but more so during the past 3 months. The child has had bowel movements which are greenish-yellow and not watery. Weight at birth was 5 pounds and 5 ounces, and this weight has increased to between 9 and 10 pounds and remained stationary at that point.

Physical examination revealed a pale, underdeveloped, poorly nourished child with a distended abdomen. The abdomen was filled with a tumor reaching from the symphysis to the ensiform which was doughy and could be pitted on pressure. The abdominal wall was thin but when attempting to palpate the tumor, marked rigidity of the abdominal muscles resulted. The heart was enlarged to the right and left and a marked systolic blow was heard at the apex, which was transmitted over the entire chest. The posterior cervical and axillary lymphatic glands were enlarged.

Rectal examination revealed a very hard mass completely filling the rectum and bulging into the anal region, which was with difficulty differentiated from a bony deformity of the pelvis, or from a bony tumor arising from the pelvis. It was in reality the lower border of a very hard fæcal impaction. This was almost entirely separated from the examining finger by a diaphragm of mucosa which was about 3 centimeters distant from the anal orifice, and in the center of which was a small opening. This obstructing membrane resembled in form the iris of the eye with the central opening corresponding to the pupil. There was no rectovaginal fistula.

X-ray examination by barium enemas showed enormous dilatation of the sigmoid, which almost completely filled the abdomen.

Operation, July 26, 1922, by Dr. V. C. David. Circular anæsthesia of the rectum by injection of one-half per cent novocaine. A small speculum was introduced into the rectum and the opening in the obstructing stricture was seen to be about 4 millimeters in diameter. Beginning with a sharp pointed artery forceps, the opening was gently dilated. The smallest cervical dilator was now used and dilatation was increased until the opening was about 1 centimeter in diameter. At this point, the diaphragm was cut through in the direction of the long axis of the bowel and further dilatation employed until an index finger could be introduced through the stricture into the bowel above, which was filled with dry, hard fæcal masses. A considerable amount of this was removed. The mucosa was now mobilized by blunt scissor dissection so that the longitudinal incision could be sutured transversely. This assured a permanent widening of the strictured area which allowed the passage of the index finger through it. It was the thought of the operator to perform the same operation on another segment of the stricture if the first operation did not gain room enough.

After history. Oil retention enemas were given each day as well as repeated retention enemas of small amounts of water. On the fourth day the child passed a large amount of fæcal matter and the large mass in the abdomen disappeared. The strictured area was examined from time to time and the index finger passed through it. A number of small fæcal impactions were broken up and passed.

In August the patient developed diarrhœa, took her food poorly, and on August 22, died.

Autopsy by Dr. H. A. Oberhelman. The enormous enlargement of the sigmoid had disappeared although the bowel was hypertrophic and somewhat larger than normal. It in no way resembled the picture obtained by X-ray before dilatation of the stricture, where the sigmoid almost completely filled the abdomen. All of the fæcal impaction had been evacuated except one mass the size of a small peach which was in the lower sigmoid. The bowel completely enclosed the mass so that it appeared to obstruct the bowel, though there was no dilatation of the bowel above it. The stricture had remained dilated to the point where the index finger could be passed through it. The mesosigmoid was greatly enlarged and the cæcum could be moved to the extreme left portion of the abdomen. The heart showed a defect in the membranous septum. A Meckel's diverticulum was present.

This typical clinical picture of infantile megacolon associated with congenital heart defect, persistent Meckel's diverticulum, cæcum mobile and a very large mesosigmoid was caused by a congenital stricture of the rectum.

CASE 2. W. M., male, age 4 years, entered the Presbyterian Hospital on the service of Dr. Dean D. Lewis, January 5, 1922, complaining of involuntary movement of the bowels and distention of the abdomen. For the first 2 years of his life, the bowels never moved spontaneously and enemas were used as a routine procedure. Since that time the movements have been spontaneous but involuntary. The child's general health was good. On abdominal examination a large mass was palpated in the region of the descending colon. X-ray shows a very large colon and an extremely distended sigmoid which crosses to the left side of the abdomen.

January 15, 1922. Median laparotomy (by Dr. Lewis) was performed and the sigmoid was found very greatly distended. Seven to eight inches in the sigmoid were resected and an end-to-end anastomosis made which was anchored extraperitoneally. Two days after the operation, the extraperitoneal bowel was opened because of marked distention of the abdomen.

April 6, 1922. The patient returned to the hospital with a colostomy opening. No fæces were passing through the rectum. I was requested to proctoscope the child and found a circular stricture of the rectum which barely admitted the tip of the index finger, about 5 centimeters above the anal orifice. Above this stricture was an impaction of fæces. This stricture was dilated by cervical dilators up to No. 21.

May 9, 1922. Patient was operated on by Dr. Lewis. Rectal dilators again passed and stricture still further opened by finger dilatation and accompanied by small incisions at the site of stricture.

September 1, 1922. The colostomy closed and bowel movements have now become spontaneous and voluntary through the rectum.

The fæcal impaction resulting from this congenital rectal stricture produced an enormous dilatation of the sigmoid resembling very accurately the clinical picture of Hirschsprung's disease.

CASE 3. J. N., female, age 7 years, entered the service of the author at Children's Memorial Hospital, August 2, 1920. The patient has had incontinence of fæces since her birth, coming in attacks each week and occurring several times a week. These attacks occur without nausea or fever but are accompanied by some pain in the region of the umbilicus, and the presence of a mass in the abdomen. These attacks clear up with the passage of an enormous bowel movement. While she was in the hospital, she complained of considerable abdominal pain, there was marked distention of the abdomen and incontinence of fæces was present.

Examination revealed a pale child with marked distention of the whole abdomen, especially around the umbilicus, and associated with general muscular rigidity. No masses were palpable. Rectal examination revealed a sickel- or valve-shaped diaphragm occluding the anterior two-thirds of the rectum, about 3 centimeters from the anal orifice. Under ether anæsthesia, this membrane was divided longitudinally, the constricture was well dilated, the mucosa was mobilized around longitudinal incision and a transverse suture of the division was made (principle of Mikulicz). The index finger could now be passed through the strictured region with ease. After the operation the patient had normal bowel movements and no involuntaries. Before discharge from the hospital, the wound had healed and the rectum was well open.

This is not a typical picture of Hirschsprung's disease but it at least falls under the heading of fæcal impaction and incomplete obstruction of the bowel due to congenital rectal stricture.

These three cases emphasize the importance of purely mechanical factors in the production of megacolon which in two instances, at least, simulated very closely the clinical picture of Hirschsprung's disease. The relief of this mechanical obstruction by appropriate operative measures resulted in prompt regression of the megacolon.

In looking through the literature on Hirschsprung's disease and megacolon, there is little

mention of congenital rectal stricture as an etiological factor. Treves reported a case in 1898 of a child 5 years of age, which had had a megacolon from birth. A laparotomy was performed and the pelvic portion of the rectum was found to be tubular and no larger than an adult index finger. An opening was made in the dilated colon above the recto-sigmoid junction and an abnormal valve-like fold of mucosa found to lie over the rectal tube. Treves states his belief to be that megacolon in childhood and infancy is not usually idiopathic but dependent on some other definite obstructive factor.

No other record of megacolon in childhood associated with a congenital rectal stricture was found, though undoubtedly they have been observed. It is my belief that careful rectal examination in cases of infantile megacolon will bring to light etiological factors of importance in some of the cases.

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HYSTERECTOMY IN CERTAIN CASES OF PULMONARY TUBERCULOSIS; PARTICULARLY AS AN ALTERNATIVE FOR THERAPEUTIC ABORTION

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LITTLE need be said at this time of the advisability of therapeutic abortion in certain cases of pregnancy complicated with pulmonary tuberculosis. Reference to two leading authorities will suffice:

Maurice Fishberg, of New York, in the third edition of his book on *Pulmonary Tuberculosis* (1922), says (p. 580): "The vast majority of modern writers maintain that pregnancy, labor, and lactation are liable to reactivate latent tuberculosis, and aggravate active lesions, often leading to a fatal termination of otherwise favorable cases." In regard to the treatment of these cases he says (p. 675): "Married women with active tuberculosis are to be given detailed instruction in the proper methods of prevention of conception. If they become pregnant the induction of abortion is indicated and justified both for the sake of the prospective child, which is bound to become tuberculous unless removed from the proximity of the mother immediately after birth, and for the sake of the mother, who is liable to succumb to acute or subacute tuberculosis soon after childbirth."

F. M. Pottenger, of Monrovia, California (SURGERY, GYNECOLOGY AND OBSTETRICS, November, 1921, p. 353), in a discussion of tuberculosis in pregnancy, dwells quite at length on therapeutic abortions. He says: "Because of the serious effects of tuberculosis complicated by pregnancy upon the mother, interruption of pregnancy has now become the common rule in the treatment of tuberculous women, but if we follow up the after-history of these cases we cannot be other than convinced that even this measure fails in a large percentage of cases and the best way to safeguard the tuber-

culous woman consists in preventing conception. . . . The average patient with active tuberculosis, whether it be in the early or the late stage of the disease, is compelled to put up a hard fight to regain health. When the strain of pregnancy is added a strong adverse factor is injected. . . . Even at the best, however, pregnancy is a complication which must be considered as extremely hazardous for a tuberculous woman. Maragliano has been so impressed with its injurious influence in such cases that he says all sentiment should be thrown aside and pregnancy should be interrupted in the interest of the mother as soon as the diagnosis is made. . . . While interruption of pregnancy sometimes fails, it offers the patient the best chance to overcome her disease. The favorable effects are most evident, as would be expected, in the early cases. In these, improvement of the tuberculosis usually follows. The procedure is the least beneficial in the advanced cases, many of which are apt to go on to increased activity. It can be said of the latter type of patient, however, that her chances are undoubtedly improved by the operation. . . . Statistics show that early tuberculosis goes on favorably after the interruption of pregnancy in 87.9 per cent of the cases, and that 33.3 per cent of moderately advanced cases and 29.4 per cent of far advanced cases are benefited."

CASE 1. February 18, 1922, a patient was referred to me by Drs. C. O. Probst, medical director of the Columbus Tuberculosis Clinic, and J. O. Welch, the patient's family physician, for the purpose of producing a therapeutic abortion. Mrs. H. S. T., age 42, married 20 years; one child aged 17. One miscarriage 13 years ago. Patient had been under the supervision of Dr. Probst for 4 years. She was in the State Tuberculosis Sanatorium at Mt. Vernon for a long while, and had taken precautions against pregnancy. She menstruated last in November. During the years that Dr. Probst had been in attendance she had had two relapses. He was consulted after it was found that she was pregnant, and after giving her case thorough investigation he felt that the uterus should be emptied as he thought a third relapse would be fatal. Examination of the patient showed her to be a slender woman with thin abdominal walls; uterus entirely movable, but apparently a little irregular in outline; some scar tissue in the cervix.

I had been called upon a number of times by different physicians to perform similar services, and had aborted with no idea of any other line of treatment; but while examining this patient it was suddenly impressed upon me that I could make a panhysterectomy in her case in about 15 minutes; there would be no hæmorrhage, no shock; there would almost certainly be prompt and complete convalescence; there would be no further pregnancies, and no loss of menstrual blood; whereas, if I merely emptied the uterus in the usual way, there would necessarily be more or less hæmorrhage, almost certainly more or less dribbling and leucorrhœa, and subsequent periodical loss of menstrual blood. The more I thought of this alternative the more favorable the proposition seemed. I talked it over, therefore, at once with her two physicians, and they promptly agreed with me in my suggestion, as did also the patient and her husband. The operation was made in the usual way, saving one ovary and its tube because of her comparative youth. Her appendix had been removed in 1913. She made an excellent operative recovery, has been entirely well since then as to her pelvic organs, and her general health is much better than it had been for years.

CASE 2. Mrs. M. E. H., age 18, married 4½ months. May 1, 1922, patient was referred to me by Drs. Griffin and Probst. She had been first met by Dr. Probst at the Tuberculosis Clinic in November. Without seeking advice she was married in December. She menstruated last, February 15. She had been having weak lungs indefinitely, and there was a good deal of tuberculosis on both sides of the family. She had lost 16 pounds in weight in the last 3 weeks. She had had considerable leucorrhœa for the last year, and had had hæmoptysis twice within the last 10 days. I found the patient a very slender woman and so weak that she had to be helped by her husband across the sidewalk into my office. Everything indicated a normal pregnancy of the time mentioned. In this case, as in the other, the matter of hysterectomy was discussed with her physicians, and we all agreed on its propriety, as did the patient, her husband, and family. A panhysterectomy was made the following day, but both ovaries and tubes were saved. The appendix was removed. Patient made a rapid convalescence, and when seen a few weeks ago had gained 24 pounds in weight and was feeling perfectly well, and was very happy.

CASE 3. Mrs. A. P., age 35, married 15 years; three children, youngest 8 years. Miscarriages, one. Patient had suffered from procidentia for years, the womb coming down between her thighs. She had been taking precautions against pregnancy. She had missed menstruation 3 months before. She had been studied by two physicians. She was having a good deal of cough and a great deal of expectoration, with febrile disturbance. On examining her I found a very slender sick woman, clearly pregnant. There was a suspicion of a tumor involving the right horn of the uterus; a rather boggy uterine mass; deep laceration of the cervix; a large rectocele; pulse 124 and feeble; prolonged expiratory murmur over both lungs with now and then râles. I talked over her

case with her physicians and husband, and hysterectomy was decided upon with perineal repair. The operation was done June 29, 1922. I did an abdominal panhysterectomy but saved the left ovary and tube. I removed the appendix. After completing the operation I made a posterior colporrhaphy and perineorrhaphy and extracted some bad teeth. Patient made a prompt recovery, and has been repeatedly reported by her husband as "in fine shape."

CASE 4. Mrs. C. B., age 28, married 5½ years; one child age 3 years. Normal labor; no miscarriages. Patient had never been really well since the birth of her child. She was at Tucson, Arizona, for 10 months for tuberculosis. She returned home October 1, 1922. She commenced ailing almost at once with colds, etc. She never had any profuse expectoration but the microscope had shown tuberculosis. She became pregnant about the first of January and had been running down very rapidly since then. She had a good deal of leucorrhœa, and an unusual amount of vomiting of pregnancy. She had had several hæmorrhages. Dr. Danford had made a diagnosis of acute exacerbation of her tuberculosis, and sent her in with the idea of hysterectomy instead of therapeutic abortion. Dr. Harper, of the Tuberculosis Clinic, found ample evidence of tuberculosis of both lungs. In one apex he thought it had healed, but there was a patch of active tuberculosis in the other apex. He heartily approved of Dr. Danford's suggestion of hysterectomy. My examination was limited to the pelvis. It showed a good perineum and vagina, some scar tissue in the cervix, the parts quite tender. She had been clearly pregnant about 2 months. February 10, 1923, I did the usual panhysterectomy, but saved both ovaries and tubes. The round ligaments were implanted. The appendix, bedded in adhesions and thick-walled, was removed. Examination of the uterus showed it to be considerably larger than would be expected with a pregnancy, so that she probably had had a good deal of hyperplasia before becoming pregnant. This patient is convalescing beautifully, but the operation is too recent for any conclusion.

From making a hysterectomy instead of a therapeutic abortion in pregnant women with pulmonary tuberculosis, it was a natural step to extend the operation to tuberculous women in whom pregnancy would be highly undesirable, and who were handicapped by the monthly loss of blood, profuse leucorrhœa, or uterine hyperplasia with all its distressing symptoms of backache, bearing down, dyspareunia, etc. Two such cases presented themselves at this time, and the suggestion was carried into effect.

CASE 5. Mrs. I. M. E., age 32, married 8 years; two children, the youngest aged 3 years. No miscarriages. Patient was seen August 13, 1922. Menstruation had been regular, but the flow large and frequently with clots. She had some leucorrhœa; much backache. She tires easily. She has pronounced dyspareunia. She has had lung trouble for 3 or 4 years. Weight 90 pounds. Her case had been studied at the State Sanatorium at Mt. Vernon, and she had made arrangements to enter the institution within a few weeks. On examining her I found a good vagina and perineum; lacerated cervix; the uterus enlarged and quite tender. I discussed her case with her family physician, and we both advised hysterectomy. She was operated upon August 18, 1922. I did the usual panhysterectomy except that both ovaries and tubes were saved, the appendix was removed. Patient made a prompt recovery, and a month later entered the Tuberculosis Sanatorium as had been planned, for a prolonged rest. Three months later she reported that she had gained 19 pounds in weight, had a fine appetite, was sleeping well, pulse and temperature within normal limits, and she was feeling better than she had felt for years.

CASE 6. Mrs. H. W., age 29, married 8 years; five children, age of youngest 3½ months. No miscarriages. Patient was seen September 7, 1922. She had been dribbling ever since the birth of the last child. This child and two others were dead. She had always been slender, but had been losing flesh since the last child was born. She was chilly at times, and had a continuous fever. She had been coughing a good deal for 2 months. I found her a very slender woman, and relaxed perineum and vagina; lacerated cervix; uterus enlarged and very tender; abdominal walls thin. Sputum was examined and pronounced tuberculous. Operation September 9, a panhysterectomy except that the left ovary and tube were saved. I removed the appendix, and closed the incision and then made a repair of the posterior vaginal wall and perineum. I extracted a few bad teeth. The patient made an excellent operative recovery, and went home in due time.

This patient was farther advanced in her disease than any of the others. She was a foreigner and decidedly pessimistic. Her physician told me that her home environment was unfavorable, and she opposed my suggestion as to her entering the Tuberculosis Sanatorium. She went home feeling much better than when she came for her operation, and later the doctor reported that she was in most respects much better than before, but that the disease was progressing and he did not believe the ultimate result would be otherwise than a fatal termination. He was sorry that she had not been sent in for operation while the disease was in an earlier stage.

Soon after operating on these cases I wrote to Dr. Pottenger, asking his opinion of the procedure, as I felt he had had an enormous experience and a remarkably wide field of observation. Under date of October 26, 1922, he writes:

"I believe that you have devised a method of satisfactorily taking care of a certain group of tuberculous cases complicated by pregnancy. I do not believe it would be necessary in all, but in advanced cases I can see how it would offer a maximum benefit with a minimum of physiologic disturbance.

"Since dictating the above I have been thinking of the explanation of why your hysterectomy patients did so much better than those in whom a therapeutic abortion is performed. In tuberculosis we find that women are very apt to have an increased activity, accompanied by increased symptoms, including temperature—usually coming on either a few days before the period or immediately following it. In accordance with the theory of Jobling and Petersen, this is probably due to the fact that at this time new enzymes, those associated with the function of menstruation, are thrown into the blood stream and that the antiferment which is binding the enzymes which break down the tuberculous tissue are released from the tuberculous enzymes and for the time being bind the enzymes connected with menstruation. As a consequence of this, the tuberculous enzymes become active and there is very apt to be an increase in autolysis in the tuberculous focus. Now, this same thing happens following the therapeutic abortion or delivery at term. The involution of the uterus, following delivery, is carried on by enzymes, and these gaining access to the blood stream, bind the antiferment and free the tuberculous enzymes to carry on the digestive process about the tuberculous focus.

"While this may not be the exact explanation, it certainly gives us a working conception that offers a plausible explanation for the thing that we all see happen. Hysterectomy, by removing the uterus, relieves the necessity of involution and thus saves the patient the danger which comes from the extra enzyme action during that time."

In his letter Dr. Pottenger thinks that he has seen in some German journal a reference to the same operation, but thinks the matter was never followed up.

Investigation through Dr. Ramsay Spillman, of the Library of the Surgeon General's Office at Washington, results in finding but one article suggesting anything along this line of treatment, and that article is probably the one referred to by Dr. Pottenger. This article is by H. von Bardeleben.[1] In this paper the author recommends merely such a partial amputation of the body of the uterus as will remove the placental site, since, according to him, the placenta is frequently tuberculous and may thus reinfect the patient. He reports a number of cases but without details.

Bandelier and Roepke[2] refer to the article by von Bardeleben, and advise the removal of the uterus when that operation becomes necessary in advanced pregnancy. They advise against the removal of the appendages in these cases because of trophic, vasomotor, and psychic disturbances which would be apt to follow, and which might favor the extension of the tuberculous process.

A good many years ago I operated upon an unmarried woman, age 26, who was apparently hopeless from a generalized tuberculosis. Both lungs were involved, there had been quite rapid loss of flesh, profuse diarrhœa, loss of appetite, etc., while in addition there was involvement of one elbow, the joint being disorganized and greatly enlarged, with multiple sinuses; also a sinus going down to the posterior superior spinous process of the ilium; cough with much expectoration, and amenorrhœa of six months' standing. The case seemed so hopeless that I finally operated only at the insistence of the mother. Resection of the joint, to get rid of the source of most of her pain, showed that the disease had extended nearly to the upper end of the humerus and downward nearly to the wrist; accordingly amputation was made just below the shoulder. The wound healed by first intention, and for the first time in many weeks she was able to have a night's rest. A few weeks later I removed the detached spinous process. Improvement was very rapid, and a few months later she had apparently been restored to full health. I kept track of the case until she left the city about 10 years later.

This case presents a distinct illustration of what I have seen repeatedly, though in less marked cases; viz., after getting rid of a large part of the tuberculous disease, nature asserts herself and the patient recovers from what remains. It has seemed to me that this case was a fair illustration of what we might expect to gain by putting a stop to the menstrual loss

[1] Med. Klin., 1912, viii, 1592-94 and 1636-40.
[2] Die Klinik der Tuberkulose. 3d ed. Wuerzburg, 1914, p. 497.

of blood, or by getting rid of a more or less diseased uterus which is handicapping the patient.

Since making the first operation I have talked with a considerable number of physicians, and have corresponded with others, and I cannot find that this line of treatment had previously been suggested, and yet it has seemed to impress all with whom I have discussed it as an exceedingly reasonable proposition. One of the surgeons of the Woman's Hospital in New York, with whom I discussed the matter a few months ago, was particularly impressed with it, and expressed regret that he had not thought of it some time before when he had simply emptied the uterus in a case referred to him, the abortion being attended not only with immediate hæmorrhage but with dribbling of blood for four months.

Nature has suggested this line of treatment by herself putting a stop to menstruation in very many cases, particularly in young women, at the very beginning of pulmonary tuberculosis.

This paper is not designed as an argument for indiscriminate hysterectomy in cases of tuberculosis, but as a plea for that operation in properly selected cases, and after due consultation with the internist, the friends, and particularly the patient herself.

I stated that in these cases, where there are no complications and the patient is of reasonably spare build, a hysterectomy can be made in 15 minutes from the first incision to the adjustment of the last stitch in closing the wound. This means that the entire womb is removed, so that no cervix is left for future trouble; the round and broad ligaments are brought in so as to support the vagina; there is complete peritonealization of the floor of the pelvis; the appendix is removed; the gall bladder examined, and the incision closed in layers as usual. If there are extensive adhesions present, or perineal repair necessary, the time will be somewhat increased, but except under extreme circumstances no *competent* operator should require over 30 minutes for an operation of this kind.[1]

Ether. I have operated many times on more or less advanced cases of pulmonary tuberculosis, and have invariably used ether by the open drop method. I have never seen the slightest evidence of any trouble arising from its use, and it is well known that not long ago certain physicians were advising prolonged etherization as a therapeutic measure in pulmonary tuberculosis.

CONCLUSION

In properly selected cases of pulmonary tuberculosis with pregnancy as a complication, or relatively too profuse or frequent menstruation, particularly in the presence of traumatism from childbearing, or uterine hyperplasia, a panhysterectomy, with as a rule saving of the appendages if the patient is young, will remove a most serious handicap and give the patient the best possible opportunity to attain recovery from the primary disease.

[1] For full description of my technique see Am. J. Obst. 1917, lxxv, No. 2.

BLOOD PRESSURE IN THE NEWBORN FOLLOWING NORMAL AND PATHOLOGICAL LABOR[1]

By RALPH A. REIS, S.B., M.D., and ARTHUR J. CHALOUPKA, S.B., M.D., Chicago
From the Maternity of the Michael Reese Hospital

SINCE Vierordt (12) in 1894 first attempted to take blood-pressure readings in the newborn, considerable work has been done along this line by different investigators using various types of instruments. Neu (7), using the Gaertner tonometer, found the systolic blood pressure in normal newborn to be 90 millimeters mercury and Trumpp (11) estimated it between 60 and 90 millimeters. Oppenheimer and Bauchwitz (8) and Gundobin (3) found the average systolic pressure to be between 60 and 80 millimeters, using the Riva-Rocci instrument, while Popoff (9) found it to be between 40 and 70 millimeters with the same instrument. Seitz and Becker (10) more recently found the normal systolic pressure to be 43 millimeters on the first day, 60 at one week, and 70 at two weeks of age. Balard (1) obtained a maximum of 55 and a minimum of 35 on the first day by means of the Pachon oscillometer. Most of these readings were obtained from a few scattered cases, no attempt being made to follow either the blood pressure day by day, or the variations due to pathological labors.

According to Howell (4) and other physiologists, the blood pressure is produced by a combination of three factors: first, the force of the heart; second, the blood volume; and third, the peripheral resistance. It must necessarily follow that the blood pressure in newborn infants is low since all factors are especially low in the newborn. Seitz and Becker give the blood volume as one-nineteenth of the body weight whereas in the adult it is one-thirteenth. In the newborn the left heart is not fully developed, particularly in comparison with the right heart. The peripheral resistance is slight because of the lack of development of the elastic fibers and muscle coats of the arteries, as worked out by Fuchs (2) and also Jores (5).

In this investigation all types of deliveries were studied in order to determine, first, the daily blood pressure following normal deliveries; second, the effects of operative deliveries, and third, the influence of any other factors. Our one hundred cases therefore include 55 cases following normal spontaneous deliveries in normal gravidæ: 10 cases of low forceps, 6 cases of mid-plane forceps, 1 breech delivery, 6 cases of version and extraction, 1 face presentation, 2 cases delivered by abdominal cæsarean section, 2 premature infants, 6 sets of twins, and 5 cases showing unusual variations. When this work was undertaken, daily readings were made on every infant until there were as many on the list as could be accurately examined each evening. Thereafter additional newborn were added to replace the cases completed on the tenth day. This lists represents, therefore, neither 100 consecutive cases nor 100 picked cases which explains the presence of only one breech delivery as against 6 cases of version and extraction and 16 forceps deliveries.

TECHNIQUE

The blood-pressure readings here reported were all taken with a mercury manometer and an arm band 6 centimeters in width. At first the auscultatory method was tried but found to be too inaccurate. The palpatory method was then used as follows: All readings were taken immediately after the 6 o'clock evening feeding when the infants were quiet and dozing, no readings being taken while the infants were restless or crying. The cuff was applied to the left arm in every instance because it is a rule at the Michael Reese Maternity that every infant's identification tag must be sewed on the right wrist and this interfered with palpating the pulse on the right wrist. The cuff was then inflated with sufficient air to occlude the radial pulse. It was then allowed to fall gradually until the pulse reappeared, at which point the reading was taken as the systolic blood pressure. To

[1] Read before the Chicago Gynecological Society, February 16, 1923. (For discussion, see page 238.)

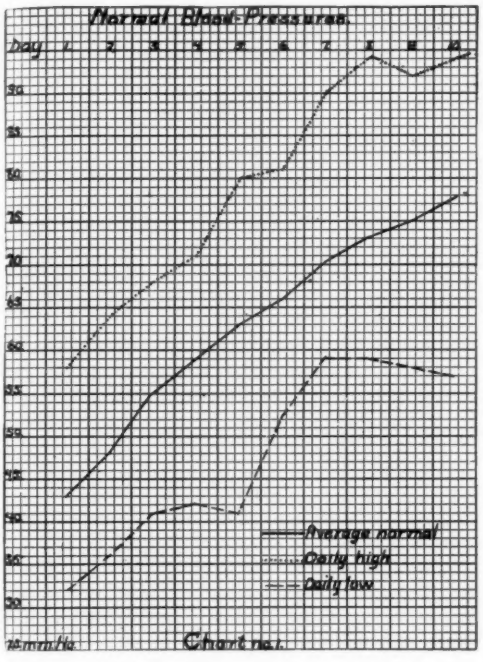

Chart 1. Blood-pressure readings in normal infants.

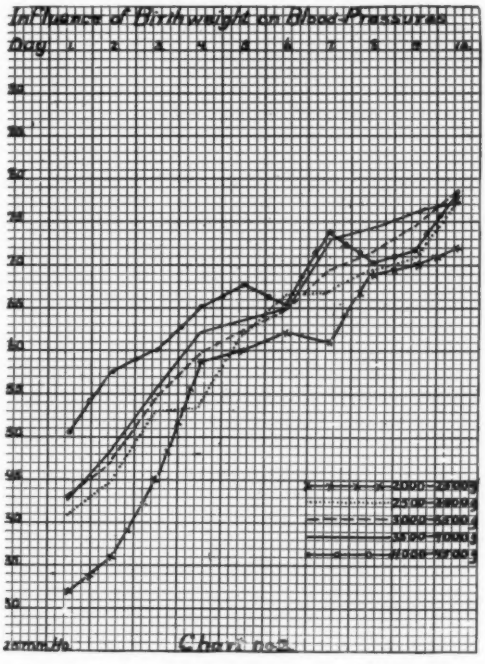

Chart 2. Relation of blood pressure and birth weight.

avoid possible errors, one of us inflated the cuff and noted the readings while the other felt the pulse, alternating every evening.

As a further check, every case showing an unusual reading was done by both of us. Four readings were taken in each case, each evening, and the average recorded. The one hundred newborn infants were followed through in this manner for the first 10 days of life. It was impossible to take readings over a longer period of time because normal patients are discharged on the eleventh day.

NORMAL CASES

We have found from a study of 55 cases that the average systolic blood pressure on the first day of life in newborn infants following normal spontaneous deliveries, is 43 millimeters mercury. The minimum reading found on the first day was 32 millimeters, obtained in a case weighing only 2300 grams at birth and following a pregnancy of 38 weeks. Later we will show that both prematurity and small size lower the blood pressure, but we felt that, with a prematurity of only 2 weeks, this case should be included among the normal cases. The maximum reading recorded on the first day was 58 millimeters in a primiparous baby weighing 4180 grams. Parity also influences the systolic pressure and this, together with the large size of this baby, readily explains the high readings.

TABLE I.—AVERAGE DAILY BLOOD-PRESSURE READINGS IN NORMAL NEWBORN

Day	1	2	3	4	5	6	7	8	9	10
Average	43	48	55	59	63	66	70	73	75	78
Daily high	58	64	68	71	80	81	90	94	92	94
Daily low	32	36	41	42	41	52	59	59	58	57

From Table I (see also Chart 1) it can be seen that there is a gradual daily increase in blood pressure, more marked during the first 3 days than later, until on the tenth day the average reading is 78 millimeters. Seitz and Becker in their four readings taken on the first day, obtained the same average of 43 millimeters and also found a more

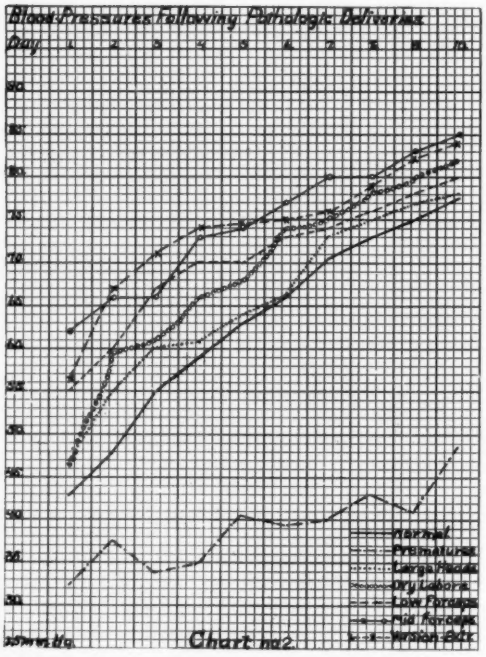

Chart 3. Blood pressure following pathological deliveries.

rapid rise during the first 3 days than later, their figures corresponding exactly with ours. After the first 3 days, however, our figures are higher, their 12 readings on the tenth day averaging only 66 millimeters.

FACTORS INFLUENCING BLOOD PRESSURE

Weight. If we classify our normal cases on the basis of birth weights, it will be seen that with the higher birth weights, the blood pressure is, in general, higher. This holds true not only for the first day but for the other days as well (see Chart 2). The average daily rise, however, is the same throughout.

TABLE II.—RELATION OF BLOOD PRESSURE TO BIRTH WEIGHT

Weight	Cases	1	2	3	4	5	6	7	8	9	10
2250–2500	1	32	36	45	59	60	62	61	69	70	72
2500–2750	4	41	43	56	51	65	67	68	68	71	79
2750–3000	6	41	47	50	56	60	66	66	71	72	77
3000–3250	7	42	46	52	58	61	63	68	71	73	80
3250–3500	13	44	49	57	60	64	68	71	72	76	77
3500–3750	9	42	46	54	58	63	63	68	71	73	73
3750–4000	6	43	51	57	66	64	67	78	78	80	81
4000–4250	4	51	58	58	62	63	68	72	74	75	81
4250–4500	1	50	58	62	68	72	63	75	64	68	73
4500–4750	2	56	60	63	63	64	68	73	73	83	84
4750–5000	1	46	45	56	60	62	65	69	70	74	..
5000–5250	1	52	57	68	74	71	68	81	88	81	83

The daily weight change does not influence the blood-pressure rise, the readings being higher day by day irrespective of the loss or gain in weight. It is also of interest to note that the greatest rise in blood pressure is during the first 3 days, during the time of the physiological loss in weight, and is apparently uninfluenced by it. This can be explained by the rapid increase in blood volume during the first 3 days of life on the basis of recent investigations of Mayers (6) and others. Mayers found the average erythrocyte count to be 7,630,000 per centimeter on the first day, after which it dropped to 6,100,000 by the fourth day and concludes that this drop is due to the fluid intake and a corresponding increase in blood volume.

Parity. Parity has very little effect upon the blood pressure, except that children of primiparæ with a long second stage of labor do show a slight increase over the normal during the first 4 days.

TABLE III.—RELATION OF BLOOD PRESSURE TO PARITY

Para	Cases	1	2	3	4	5	6	7	8	9	10
I	16	44	49	54	57	62	66	71	75	76	80
II	13	42	49	56	59	61	68	70	72	74	77
III	8	44	50	56	60	62	65	72	74	73	76
IV	3	43	49	52	62	69	69	74	75	77	78
V	6	44	50	56	59	62	66	66	70	76	81
VI	5	41	48	53	56	51	62	63	63	71	76
VII	2	39	48	62	62	66	63	74	73	74	75
VIII	1	40	43	58	65	60	63	63	62	70	78
IX	1	40	43	45	64	61	64	80	8c	82	7)

TABLE IV.—RELATION OF LENGTH OF SECOND STAGE

	Cases	1	2	3	4	5	6	7	8	9	10
Under 30 min	9	43	47	55	60	60	65	71	72	77	76
30 min to 1 hr	17	44	49	56	60	63	66	72	78	79	78
1 hr. to 1 hr. 30 min.	7	44	48	53	59	63	67	70	74	75	77
1 hr. 30 mn. to 2 hr.	10	43	47	55	59	63	65	69	73	74	78
2 hr. to 2 hr. 30 min.	8	41	48	55	58	63	66	70	74	74	79
2 hr. 30 min to 3 hr..	4	44	54	59	62	67	69	71	72	77	82
3 hr. to 3 hr. 30 min.	1	38	44	51	64	58	62	67	69	74	87

In Table IV, the highest blood pressures occur in those cases with a second stage of labor between 2 hours and 30 minutes and 3 hours. The lowest pressures, however, are found in cases with a second stage lasting from 1 hour and 30 minutes to 2 hours.

Cephalic measurements. The 12 cases having the largest cephalic measurements showed an average blood pressure higher than the normal especially during the first, second, and third days. Nine of these were large infants with heavy birth weights, which probably was a factor in the increase, but we believe birth trauma increases the blood

pressure and some of this increase is due to the added trauma which a large fetal head receives. This will be better shown in connection with infants delivered by operative procedures. The blood-pressure readings of the 12 cases average as shown in Table V.

TABLE V.—LARGE CEPHALIC MEASUREMENT

Day	Blood pressure
First	47
Second	55
Third	60
Fourth	61
Fifth	64
Sixth	66
Seventh	70
Eighth	75
Ninth	77
Tenth	78

The greatest increase, it will be seen, is during the first 3 days, after which the readings tend to approach the normal (see Chart 3).

Relatively dry labors. In the series of 55 normal cases, there were 14 in which the membranes had ruptured more than 2 hours before delivery. The blood pressures of these cases were averaged separately in order to determine what effect, if any, may follow the increased pressure on the head which occurs in relatively dry labors. Table VI and Chart 3 show that there is a definite increase in arterial tension above the normal most marked during the first 3 days. This is, of course, the period immediately following the trauma, and we believe that this increase in blood pressure is a direct result of the undue pressure exerted upon the head where there is no forelying bag of waters to act as dilator.

TABLE VI.—RELATIVELY DRY DELIVERY

Day	Blood pressure
First	46
Second	60
Third	61
Fourth	66
Fifth	68
Sixth	74
Seventh	76
Eighth	79
Ninth	80
Tenth	83

Caput succedaneum. The blood-pressure readings of 16 cases showing the formation of a caput succedaneum were also averaged separately and the average was found to be practically the same as that of the whole series of normal cases. It must be concluded, therefore, that the formation of a caput does not produce any increase in intracranial pressure that is demonstrable by a change in systolic blood pressure.

Other factors. Sex, the presence or absence of jaundice and temperature, and the pulse rate have no influence upon blood pressure. Balard (1) found that the newborn of toxic mothers had high blood-pressure readings. In our cases this was not found. We had 3 cases of definitely toxic mothers, showing high blood pressure, albuminuria and many casts but the blood-pressure readings in their infants were normal. The cases were also grouped according to the maternal blood pressures, but we could find no relationship between the maternal pressures and those of their newborn infants. The production of cephalahæmatoma has been attributed to high arterial pressure; in our cases this is not true, the readings being normal.

PATHOLOGICAL DELIVERIES

Low forceps cases. Infants delivered by low forceps show a distinct elevation in blood pressure. There were 10 such cases and by studying their average blood-pressure readings, it can be seen that this elevation persists throughout the first 10 days. This increase is apparent immediately on the first day at which time it is the highest, remaining so for the first 4 days (see Table VII and Chart 3.)

TABLE VII.—LOW FORCEPS CASES

Day	Blood pressure
First	55
Second	60
Third	67
Fourth	70
Fifth	70
Sixth	73
Seventh	74
Eighth	76
Ninth	78
Tenth	81

During these 4 days the average is 12 millimeters higher than the normal average. On the fifth and sixth days the increase above the normal is only 7 millimeters and during the last 4 days it gradually diminishes until, by the tenth day, the blood-pressure readings are 3 millimeters above normal.

Midplane forceps cases. Blood-pressure readings in infants delivered by midplane forceps show an even more marked increase above the normal than do the low forceps cases. Our 6 cases had an average blood pressure on the first and second days of 62 and 66 millimeters respectively, or 19 millimeters above those delivered spontaneously. From the third to the seventh days the blood pressures were 11 millimeters above normal and during the last 3 days 7 millimeters above the normal. It should be noted that, in both low and midplane forceps cases, the greatest increase above the normal is again during the first 3 days (see Table VIII and Chart 3.)

TABLE VIII.—MIDPLANE FORCEPS CASES

Day	Blood pressure
First	62
Second	66
Third	66
Fourth	73
Fifth	74
Sixth	77
Seventh	80
Eighth	80
Ninth	83
Tenth	85

Version and breech extraction. Six cases delivered by version and breech extraction showed an increased blood pressure throughout, being especially marked on the second, third and fourth days, during which period it was 15 to 18 millimeters above normal. The increase on the first day was 13 millimeters (see Table IX) and on the fourth and fifth

TABLE IX.—VERSION AND EXTRACTION CASES

Day	Blood pressure
First	56
Second	67
Third	71
Fourth	74
Fifth	74
Sixth	75
Seventh	76
Eighth	79
Ninth	83
Tenth	84

days, 10 millimeters. After the sixth day the increase was only 6 millimeters. There was one case of spontaneous breech delivery in which the blood-pressure readings were normal.

Cæsarean section cases. Two cases delivered by abdominal cæsarean section showed normal blood-pressure readings.

Face presentation. One case delivered spontaneously as a face presentation. Here also the blood-pressure readings were normal.

Prematurity. In premature infants the blood pressure is markedly lower and remains low throughout the 10 days. The more marked the prematurity, the lower the blood pressure. It should be noted that, in the 7 months premature infant, there is practically

TABLE X.—PREMATURE INFANTS

	Day	1	2	3	4	5	6	7	8	9	10
8 mos. Premature		35	34	37	34	41	42	44	47	46	61
7 mos. Premature		30	41	31	36	40	37	36	39	36	36

no rise during the first 10 days, the blood pressure remaining stationary. (Table X.) These low readings are probably due to immaturity of the circulatory apparatus. The 8 months premature infant weighed 2000 grams at birth. There was also one full-term normal infant with practically the same birth weight, and in this latter case the blood pressure, while low the first day (32 millimeters) rose daily as in other full-term infants.

Multiple pregnancies. There were 6 cases of twin pregnancies, all but Case 6 being born 2 to 4 weeks before their estimated dates. These ten babies, therefore, were all premature infants of low birth weights and, as might be expected, showed low blood-pressure readings in spite of operative deliveries. Twins No. 6 were of unusual interest. They were carried to term and when born, weighed 3970 and 2430 grams respectively. Both were delivered by breech extraction, the heavier one being the first to be delivered. The blood-pressure readings of this heavier twin correspond to our readings for breech extraction. The second twin was of average weight,

TABLE XI.—MULTIPLE PREGNANCIES

No.	Lgth. Gest.	Par.	Sex	Wt.	Delivery	1	2	3	4	5	6	7	8	9	10
1	38wks	1	m	2580	High forceps	32	37	40	43	51	51	57	63	62	69
			m	2370	Version-ext.	34	40	43	45	49	47	55	51	58	68
2	38wks	5	f	2690	Breech-ext.	34	42	43	54	52	54	52	67	65	62
			f	2200	Breech-ext.	32	31	41	47	50	53	49	64	62	59
3	36wks	1	m	2260	High forceps	36	51	58	61	58	57	66	64	63	72
			m	2030	Version-ext.	42	43	42	40	50	62	62	67	61	58
4	38wks	6	m	2840	Spont.ROA	40	47	62	65	69	68	73	69	73	78
			m	2330	Spont.ROA	38	41	61	61	64	63	71	68	72	76
5	38wks	1	f	2190	Breech-ext.	42	45	57	74	67	71	69	67	68	77
			f	1870	Breech-ext.	44	44	56	70	68	68	66	66	66	74
6	term	2	m	3970	Version ext.	61	67	71	80	88	86	88	87	90	86
			m	2430	Version-ext.	42	52	59	67	66	68	69	73	70	75

i.e., of the other twins and showed blood-pressure readings comparable to the readings found in other twins. It would seem that the low readings obtained in twins are due to prematurity and low birth weight rather than to the fact of twin pregnancy itself.

Certain cases in which there was definite clinical evidence of cerebral injury or in which the fetal head had been subjected to the trauma of prolonged and difficult labor, bring out most clearly the conclusion that such trauma causes an increased systolic blood pressure. Furthermore, with clinical improvement, the blood-pressure readings gradually approached the normal.

Case 64. Para-II, male child, birth weight 3220 grams. Presentation was a right brow anterior with no progress after 3 hours in the second stage. Podalic version and breech extraction was done and considerable difficulty encountered in delivering the aftercoming head. The pressure on the first day was 58 and the pulse 108, which was unusually low. On the second day the pressure was 68 and the pulse 100. There was a typical cerebral cry, bulging fontanelle, marked overriding of the bones of the skull, rigidity of the neck and extremities, opisthotonus, a nystagmus and increased reflexes. A spinal puncture was done and spinal fluid obtained under pressure, 8 cubic centimeters being removed. The third day the pressure was 70, the pulse still 100 and the general condition about the same. Another spinal puncture was done and 6 cubic centimeters of spinal fluid removed. The fourth day there was a slight clinical improvement and the pressure was 83, the pulse having increased in rate to 128. The child gradually recovered and as improvement set in, the blood pressure stopped rising rapidly, being 76, 76, 78, 82, 82, and 84 for the remaining days.

Case 60. Para-V, male child, birth weight 2720 grams, spontaneous right occipito-anterior with a second stage of 15 minutes. On the fourth day this case had a temperature of 101° and a pulse of 120 and suddenly became cyanotic and had a generalized convulsion lasting 5 minutes. Following this, the systolic pressure was 76 and remained that high for the following 5 days.

Case 80. Para-II, male child, birth weight 3280 grams. This was a persistent right occipito-posterior for 5 hours. Spontaneous delivery occurred while preparations were being made to perform a rotation and extraction. The blood pressure in this case was very high throughout the 10 days, being 61, 64, 72, 75, 77, 82, 90, 78, 82, 83, and 79.

Case 67. Para-II, male child, birth weight 3020 grams. The head was on the perineum for 1 hour and 30 minutes. The blood pressure on the first day was 62. Child had a typical cerebral cry and a slight rigidity of the neck. There was a loud systolic murmur replacing the first tone at the apex. On the second day the child suddenly became cyanotic and died. Unfortunately no postmortem examination was permitted.

CONCLUSIONS

1. The average systolic blood pressure during the first day of life in full-term infants, following normal spontaneous labor, is 43 millimeters mercury.

2. The blood pressure increases daily until, on the tenth day of life, the average systolic blood pressure is 78 millimeters.

3. The greatest rise is during the first 3 days, reaching 59 millimeters on the fourth day.

4. The blood pressure varies with the birth weight, being higher in heavier infants.

5. Sex, jaundice, pulse rate, and temperature and caput succedaneum with no signs of compression apparently have no influence on the blood pressure.

6. Infants delivered by abdominal cæsarean section have normal blood pressures.

7. Premature infants have low systolic blood pressures corresponding to the length of gestation.

8. Twins have low blood-pressure readings proportional to the prematurity and the birth weight.

9. The greatest increase in blood pressure is shown after midplane forceps extraction and version extraction; lesser increases were shown after low forceps extractions, relatively dry labors, prolonged second stages and in infants with large cephalic measurements.

10. The increased blood pressures found seem to be due directly to increased trauma to the fetal head.

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CHOLECYSTECTOMY WITHOUT DRAINAGE

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INSPIRED somewhat by reading the articles of Willis and Richter as to the closing of the abdominal wound without drainage after doing a cholecystectomy, and encouraged somewhat by my own convictions in the matter, it seemed to me that such a procedure would be good surgery in certain selected cases. During the past 2 years I have closed practically every abdomen from which the gall bladder was removed without the aid of any drainage whatsoever.

It appeared to me that if it is good practice to close the abdomen without drainage after an appendectomy, it should be good practice to follow the same principle after a cholecystectomy. In my estimation there are three factors that make one hesitate in doing this: (1) The question of infection; (2) The question of spilling of bile; (3) The question of the bile pressure that might occur in the remaining cystic duct.

As to infection, it is true that we do not hesitate to close many pelvic cases that are known to be infected and in which there is still pus about the peritoneum. We also do not hesitate to close without putting in abdominal drainage many cases of bowel anastomosis, in which there must be more or less liability to spread infection. Then there are many cases of appendectomy, in which the peritoneum has actually become soiled with possible sources of infection and in which we close the abdomen and the patients do very well. So, why should we worry particularly about infection from the gall-bladder region? If the gall-bladder operation is done with the same precaution as that of the appendix, i.e., as regards the spilling of bile contents, etc., I do not believe that the question of spread of infection in this type of case needs to be a factor in our ordinary operative routine. It must be admitted, however, that there are certain cases of bowel anastomosis and also certain cases of appendicitis that are operated upon, in which it is absolutely imperative to insert drainage. This holds true to some extent in the gall-bladder area: (1) ruptured gall bladders, (2) empyema of gall bladder.

I feel quite sure that it is the experience of all of us that drainage anywhere in the abdomen is apt to invite infection quite as much as it is apt to prevent the spread of infection.

As regards the spilling of bile, I do not think that there is one of us who has done gall-bladder surgery who has not at some time or other spilled large quantities of bile into the abdominal cavity, and we have depended more or less on packing to take care of this spillage. In these cases the bile is protected from the intestine but does, to some extent, drain down into the right flank, particularly outside of the cæcum. It is almost impossible with packing to take care of this leakage. It is almost impossible to wipe this material out. We have all observed that when we do insert drainage in these cases to take care of the spilling of bile that the wound really does not drain any bile but does drain large amounts of serum. The bile must then have gravitated down into the right flank, and there the peritoneum has taken care of it.

As regards pressure in the common and cystic ducts, it has been shown that this pressure amounts to only 200 to 500 millimeters of water, which is very much less than the arterial blood pressure of the average individual. We tie with catgut a large blood vessel where the pressure is much greater than we find in the common duct, and still we do not necessarily insert drainage to take care of any possible slipping of the ligature when we tie a blood vessel, but heretofore we have thought it necessary to do such a thing when we tie the cystic duct.

The outstanding complications and postoperative difficulties which have urged me to adopt this method are:

1. *Pain.* The fact that the large majority of our patients with drainage tubes inserted

down to the region of the stump of the gall bladder complain of a great deal of postoperative pain, especially during the first 48 to 72 hours. This pain always radiates up into the shoulder, and is very characteristic, resembling very much the ordinary pain experienced in gall-bladder colic.

2. *Tympany.* Many of these patients complained considerably of tympany and had nausea and vomiting after operation.

3. *Drainage.* The question of drainage itself. These wounds often drain for a long time, making the convalescence in the hospital much longer than it should be; in fact, we have sent home many patients who were draining more or less bile or seropurulent material from the wound. This has delayed the convalescence very materially.

4. *Temperature and pulse.* Many of these patients have had a marked rise in temperature and an increased pulse rate the first 2 or 3 days after operation, which always gave more or less concern.

5. *Source of infection.* Although the drainage tube was removed in 24 to 48 hours in many of these cases and although the wound apparently was normal, with no drainage of bile or pus, still in 2 or 3 days after removal of the tube pus began to come from the wound, indicating that possibly the infection came from without rather than from within.

6. *Postoperative results.* A great many of these patients in whom drainage has been used, for a long time afterward, complain of more or less pain in the region of the gall-bladder area, associated with symptoms of more or less gastric distress, undoubtedly due to adhesions. Willis has demonstrated experimentally and otherwise that when drainage is used and particularly when bile drains from the wound, adhesions are apt to form and that these adhesions are very dense in character. This in itself should speak against the use of drainage in these cases.

7. *Postoperative hernia.* Although postoperative hernia is not a common incident, the danger of its occurrence is much greater when drainage is used than when the wound is closed without drainage.

A review of the literature shows that as far back as 1905, Witzel reported 500 cases in which he closed the peritoneum without drainage. However, he describes in much detail, the closing in of the cystic duct. About the same time, Robson and Moynihan also advocated, or at least suggested, that in certain cases it might be advisable to close the abdomen without drainage. Most of the literature in this country comes from the clinics of Richter and Willis and from Richter's former pupil, Buchbinder. Richter, of Chicago, was probably more or less of a pioneer in this work in this country. He reported his cases in 1916, and Willis reported his series in 1917, since which time both of them have again reappeared in print with more data, and a very much larger series of cases.

The technique for removal of the gall bladder used by these men has varied considerably. Witzel started out by doing a Lambert over the cystic duct. One author ties the duct by making a cuff of the mucous membrane and then tying the duct and allowing the mucous membrane to fall back over the cut end. Another author carbolizes the end of the stump. Still another operator puts a double ligature about the cystic duct and buries it back of the peritoneal surface covering the liver. One of the more recent writers becomes still more bold and just simply ties the duct with a plain No. 0 or No. 1 catgut and drops it back in the wound. This is similar to the method by which Morris removes the appendix. Some prefer to remove the gall bladder from above downward, and some from below upward. It is probably largely a matter of choice in their own particular method.

It has been my practice to remove the gall bladder from below upward. I expose the gall-bladder region by a modified curved incision, so as to bring the liver out as well as possible. With the Mayo scissors I separate the peritoneal covering over the cystic duct, and dissect out the duct itself so that it stands out and is seen very distinctly. It is quite important that none of the loose connective tissue is included in the dissection. The duct itself must be clearly found and isolated. I clamp both the distal and proximal ends, placing the two clamps as near together as possible, and cut between the

clamps so as to lessen the spilling of bile contents or infection. I then isolate the cystic artery and tie. By cutting the peritoneal reflection across the gall bladder so as to leave a flap on each side where the bed of the gall bladder would naturally be after removal, and by dissecting from below upward, I remove the gall bladder by blunt dissection or scissors. I have, then, in my desire to be as safe as possible, ligated the cystic duct in two separate places with a formalized No. 0 or No. 1 catgut. On account of the depth of the wound, one must be very careful to see that the ligature is tied very tightly. When one is sure of the ligation the common duct may be dropped back into the wound. The artery is ligated separately. A running catgut stitch is made, starting from below and running upward, catching the layer of peritoneum that has been reflected backward, so as to leave a running closed peritoneal surface on the inner side of the liver. It is needless to say, of course, that before removing the gall bladder, it is very essential to hold back with moist gauze, the intestine, the stomach, and duodenum so as to have a good field. I have found that if present, oozing from the liver surface after removal of the gall bladder is easily controlled by the application of hot packs. The wound is then closed tightly.

I do not mean to infer that in every case in which the gall bladder is removed the wound should be closed without drainage; for instance, in one case during the past year, in which there was a ruptured gall bladder, I inserted drainage, although in this particular case I feel confident now that I would have been perfectly safe had I closed without drainage. I would, however, drain (1) when bleeding cannot be controlled, (2) when empyema of the gall bladder is present, and (3) when, for some reason, it is necessary to insert drainage into the common duct, as occurred in two of our cases.

I have reviewed the cases occurring in my service during the years 1920, 1921, and 1922, and find that I have done a total of 80 gall-bladder removals during this time; 50 of these cases have been closed without drainage and 30 with drainage. Most of those with drainage were done during the year 1920. I have attempted in this study to bring out some comparative statistics, and although I had my own convictions before the statistics were made, they do confirm the opinion that I previously held.

Temperature. Taking the highest temperature point within the first 4 days after operation, we found that of a total of 30 cases with drainage, 8 had a temperature of 99°; 5 a temperature of 101°; 1 a temperature of 102°; 2, of 103°; 1, of 105°. In those cases without drainage, 16 had a temperature of 99°; 3 a temperature of 101°; 5 a temperature of 102°; 1 a temperature of 103°. However, in those cases with a temperature of 102° or more, 3 of them developed postoperative pneumonia, and 2 postoperative bronchitis.

Tympany. We find that tympany after operation in the cases with drainage was present in 18, absent in 10. In those cases without drainage, 6 had tympany, and 42 none.

Pain. I have classified postoperative pain into three types: those with (a) no pain, (b) slight pain, and (c) severe pain. Of those with drainage, 4 had no pain, and 26 had pain. The proportion of definite statistics as regards postoperative pain is not very clear in the records for 1920. In those cases that were closed without drainage, 33 of them showed no pain, 13 slight pain, and 4 severe pain, postoperatively. In the number of those with drainage, the pain was very much more severe the first 2 or 3 days.

Stay in the hospital. We found that the average duration of the patient's stay in the hospital was 14 days, when drainage had been used, while it was 12 days, when drainage was not used. However, in 1921, in the cases without drainage, there were two patients that developed postoperative pneumonia, which delayed their convalescence, and one patient, who lived out of the city, did not wish to go home for various reasons. In three cases the convalescence was markedly delayed on account of the fact that we really did too much surgery, i.e., we did several operations on different parts of the body at the same time. This runs the average stay in the hospital up slightly, but I am positive that

the average is at least 3 or 4 days less in the uncomplicated case when no drainage is inserted.

Follow-up record. In the follow-up record of the 1921 patients (those without drainage), I find that 15 patients report as feeling fine; no report is given for 3 cases; 1 case reports no relief. Unfortunately, the 1920 cases were not so complete as to their summaries. In those cases in 1921 that can be reported without drainage, 17 cases made an absolutely uneventful convalescence. However, pneumonia developed in 2 cases, and 3 cases were pregnant at the time of operation. The 1922 follow-up report is not completed.

Mortality. There were only four deaths in the entire series, all drainage cases, but this is largely a coincidence. The first death occurred on the third day after operation from a streptococcus infection, proven by autopsy. There was absolutely no leak from the bile passages, nor from the appendix (which was removed at the same time), but it was proven that the infection came from an outside source. The second death was due to acute dilatation of the stomach 48 hours after operation; the third to massive collapse of the lung on the fifth day; the fourth to peritonitis and anuria on the eighth day.

From this review of our cases, as well as from my own personal contact with the patients, I can recommend that in practically every case of cholecystectomy it is possible, if the technique is properly carried out, to close the gall-bladder incision without drainage. If this is done, I feel certain that the postoperative pain, especially that passing up into the shoulder blade and scapula, the postoperative nausea and vomiting, the postoperative temperature, the postoperative tympany, and finally the entire convalescence, will be very much smoother and more pleasant to the patient, and to the surgeon, and that the end-result will be far more gratifying in all respects.

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DEPARTMENT OF TECHNIQUE

A TECHNIQUE FOR THE RESECTION OF GASTRIC AND DUODENAL ULCERS[1]

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WHILE the debate as to the relative merits of medical or surgical treatment in cases of duodenal ulcer continues apparently interminably, no such condition regarding similar lesions of the stomach obtains. The potential malignancy of gastric ulcer makes such a lesion at all times dangerous, and leaves small room for favorable argument from even the most enthusiastic supporters of medical treatment. The physical differences between the benign and malignant gastric ulcers are so few, and indeed so often absent in smaller lesions, that sometimes even the most experienced surgeon, with the lesion under eye and touch, is unable to differentiate the two accurately. Aschoff believes that if the original lesion is carcinoma, the base of the ulcer shows carcinomatous changes. Wilson and MacCarty have shown that the carcinomatous degeneration can be demonstrated in the overhanging edges of the ulcer, but not in the base. It is then an obvious corollary that a gastric ulcer should be subjected to surgery. The frequency with which penetration of the serous coat of the stomach occurs in these lesions, making possible an attachment to a neighboring viscus, places many difficulties in the way of the surgeon. Often these obstacles are wellnigh insurmountable within a reasonable margin of safety, and for that reason no fixed procedure is applicable to all cases. That the cautery method of Balfour is admirable for many ulcers of this perforating type has been demonstrated so often that its value is unquestionable. Resection of the entire ulcer with a cautery by cutting through normal mucosa has some adherents despite the fact that this removal cannot be carried out without considerable soiling and often a resulting deformity of the stomach, which is closed with difficulty.

Most gastric ulcers are located on the lesser curvature of the stomach in its middle third. Three-fourths of all the hard, calloused ulcers of the posterior wall, which form the most difficult group to attack by any procedure, are located in this middle third. In order to remove these ulcers for microscopic study and at the same time to be radical enough in case the lesion is malignant, the ideal technique requires ready mobilization of the ulcer area and a secondary closure which prevents contamination so far as possible, and at the same time leaves the parts free from deformity. Usually gastric ulcers which are adherent are attached firmly to the pancreas, but sometimes this perforation is found to be fixed to the liver, or the round ligament, or occasionally to the peritoneum of the abdominal wall. It is advantageous to remove this, preferably intact, in mobilizing the stomach, so that no open perforation will occur, permitting the escape of gastric contents and the spread of contamination in the peritoneal cavity.

A study of the cases of gastric ulcer at the Mayo Clinic with especial reference to their end-results and the type of operation employed has demonstrated that approximately one-third of the patients with gastric ulcer on whom resection was performed without gastro-enterostomy failed to obtain entirely satisfactory results, while a similar percentage of patients on whom gastro-enterostomy was performed, but without excision of the local lesion, had likewise obtained only partial relief, or their symptoms had not abated. Such experience makes it seem advisable to supplement excision of the gastric ulcer with gastro-enterostomy, a procedure which has been followed in all but a few cases operated on recently. In cases of duodenal ulcer, the question of malignancy does not arise, and consequently treatment by medical methods is not inadvisable in many cases.

The belief that a direct attack on the pathological condition present which is causing the symptoms is the feasible procedure in cases of ulcer of the duodenum, provided it can be accomplished without increased mortality resulting from the operation, led to our undertaking a series of excisions of ulcer without gastro-

[1] Submitted for publication April 5, 1923.

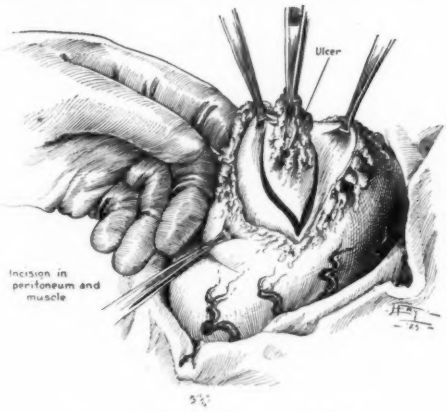

Fig. 1. Ulcer area outlined by incision.

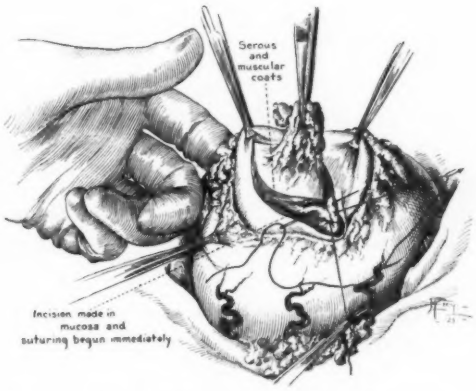

Fig. 2. Opening in mucosa and suturing of mucosa.

enterostomy, and the end-results have prompted the continuance of this method. In the light of the present knowledge of the cause of gastric and duodenal ulcers, it is logical to remove the offending lesion together with the foci of infection, rather than to trust to a side-tracking procedure which leaves a pathological entity in which healing is a moot question and in which exacerbation gives rise to a chain of symptoms similar to those for which the patient first sought relief. It should be recognized that no one method is adaptable to all cases, and that resection of duodenal ulcers should be carried out only in cases in which location and attachment permit mobilization without more risk than other recognized methods of surgical treatment.

It is estimated that about 2 to 4 per cent of gastro-enterostomized patients develop jejunal ulcers at, or near, the line of anastomosis. That this is an unfortunate sequela which is most difficult to remedy, even the most optimistic cannot deny. In a case presenting this unfortunate complication, nothing short of a radical operation fraught with many technical difficulties is worth considering, and one of the facts experience has established is that a second gastro-enterostomy following the resection of a jejunal ulcer is not well tolerated. It is then necessary to resect the primary ulcer and to apply a plastic procedure to the pylorus. Primary resection without gastro-enterostomy avoids this small percentage of cases and renders unnecessary the second formidable operation. To push any operation beyond its limits is to bring it into disrepute, and necessarily before electing to make a resection, mobilization without too much trauma and without sacrifice of too much of the blood supply, must be feasible. Finney, in his pyloroplasty has demonstrated that one is able to cut off much more of the blood supply than was formerly thought safe. The anterior duodenal vessels may be sacrificed freely and much of the supply from the pancreaticoduodenal artery may be tied off without causing damage.

An added advantage of excision with a knife is that it permits an inspection of the upper portions of the duodenum. While the greater number of duodenal ulcers occur on the anterior surface nearer the upper border, it is surprising how often unsuspected lesions are encountered on the mucosa of the posterior wall. These so-called contact ulcers are present in a fairly large percentage of cases, and the operative technique must be modified to include their destruction or extirpation. Perforation results more often in an attachment to the head of the pancreas than to any other viscus, and, when it occurs, accentuates the operative difficulties. If the ulcer is of long standing and is hard, firm, and calloused, causing sufficient pyloric stenosis to produce gastric dilatation, the simple excision is amplified by a modified pyloroplasty with gratifying results. We have found the addition of the Rammstedt technique of simply incising the muscle fibers of the pyloric ring at right angles to the opening, to be of advantage. Gastro-enterostomy to complete this operation has not been found necessary in cases of duodenal ulcer. The postoperative course of these patients has been remarkably smooth and free from such unpleasant complications as gastric retention. The end-results which have been tabulated from letters received after

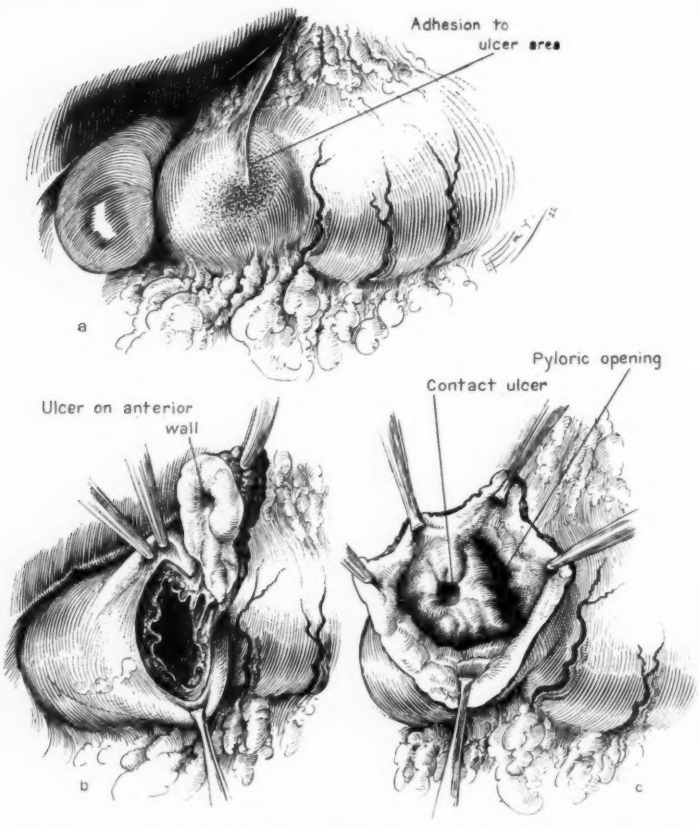

Fig. 3. *a*, Stippling at ulcer site. *b*, Ulcer on anterior duodenal wall excised. *c*, Ulcer on posterior wall exposed.

operation have been so satisfactory as to warrant the use of the technique in a larger series of cases.

It would seem that the ideal indication for resection of a duodenal ulcer would be met in the patient whose most distressing symptom has been bleeding, and indeed we have employed it in every case of this type when it was possible to remove the offending lesion without performing what seemed to be a too extensive operation. Many patients, however, who complain of bleeding have been obese and exsanguinated to such an extent that any formidable operation was considered unsafe. Very often, also, the local condition has been found to be a perforating type of lesion so remote from the operative field that its removal by accurate operative technique seemed impossible. Thus, one must be content to ligate the afferent vessels that are within reach and to perform a posterior gastro-enterostomy, or destroy the ulcer with a cautery and complete the operation in the same manner. When localized pain in the upper right quadrant of the abdomen has been the predominant symptom, it has seemed wise to excise the duodenal ulcer in all cases possible without the addition of a jejunal anastomosis. Urging the necessity of proper selection of suitable cases of duodenal ulcer for a resection without gastro-enterostomy, we feel sure that a proper use of the technique of excision, as described here, will warrant its wider application. In cases of gastric ulcer the ease and accuracy of removal and the freedom from soiling, as well as the absence of deformity in the finished result, has prompted the adoption of this technique in a large series of cases, the end-results of which have been entirely satisfactory.

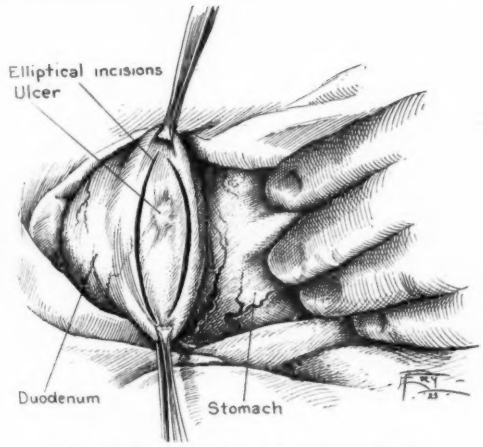

Fig. 4. Two elliptical incisions around ulcer.

OPERATIVE TECHNIQUE

Gastric ulcers. Adequate exposure through an ample working incision is a cardinal principle in all plastic surgery, and a modification of the high right-rectus incision popularized by Bevan has been found to be the one of choice. This incision begins at the xyphoid cartilage and extends obliquely downward and outward to a point 1 inch opposite the umbilicus. The round ligament of the liver, which is now known to have no function of suspension, is divided between clamps and may be reunited by ligature or suture at the end of the operation. It is essential to ligate both cut ends of the ligament because of subsequent hæmorrhage which may occur from the small vessel which accompanies it. This step increases the exposure markedly because the proximal end of the ligament may be used as a retractor to draw the overhanging left lobe of the liver out of the operative field. Mobilization of the stomach by separating the attachments to neighboring organs can be made either by approach from above, through the gastrohepatic omentum, or from below, through the transverse mesocolon; the approach from above downward is generally preferable.

By dividing the gastrohepatic omentum and ligating the gastric artery on both sides of the ulcer with the surrounding inflammatory mass, the site of attack is brought into the operative field by traction on the stomach by an assistant. Having freed the mass from its attachment by sharp dissection, the raw surface of the pancreas or liver is sutured over with catgut. This is advantageous in preventing subsequent adhesions and consequent deformity. The operative field is caught with an Allis forceps on the posterior wall, and an assistant holds the anterior wall of the stomach directly opposite. A circular incision

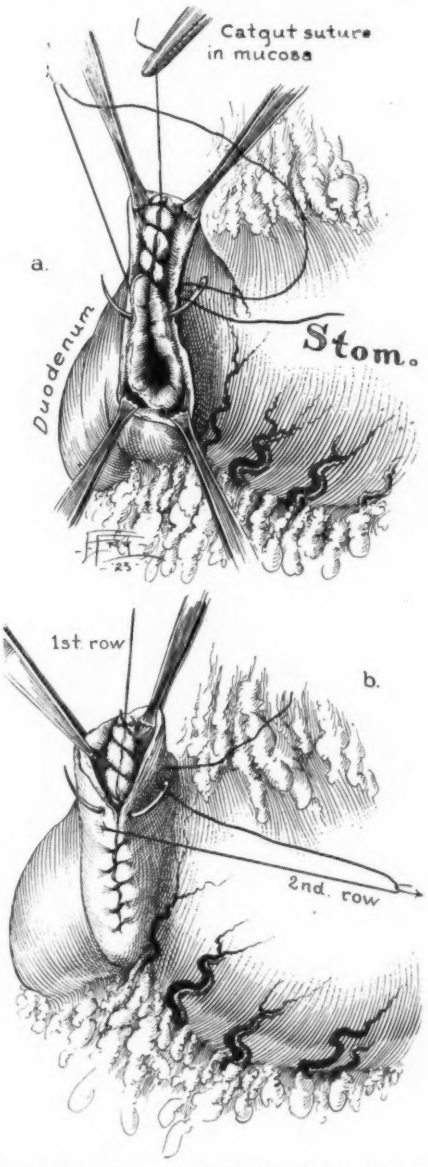

Fig. 5. *a*, Suturing mucosa separately. *b*, Suturing muscle and peritoneum.

Fig. 6. Rammstedt addition used where the pyloric muscle is tense.

through the serous coat outlines the amount of tissue to be sacrificed. The incision is then carried down through the muscular coat to the mucosa, care being taken not to open the mucous membrane until the entire dissection is complete. Having completed this part of the operation, a small opening in the mucosa is made at the lowest point on the anterior gastric wall, and here the suture of chronic catgut is started immediately. The operator with one finger posterior to the mucosa controls the escape of any gastric contents simply by pressing the two walls of the stomach together at the opening. As the incision is carried higher and higher in the mucosa on both margins of the opening, the suture is continued so that the opening is closed as soon as it is made, and there is little or no contamination from leakage of gastric contents (Figs. 1 and 2). Another layer of catgut suture inverts the muscular and serous coats, and a few interrupted silk sutures, which take off any possible tension from the catgut line, are placed over the entire area of resection. The gastrohepatic omentum, or any adjacent fat tags which are available, are sutured down over the operative site. An all catgut gastro-enterostomy is made at the most dependent portion of the stomach on its posterior walls. The advantages of controlling hæmorrhage by direct suture of mucous membranes and of preventing soiling by suturing the opening as soon as it is made, are obvious. The difficulty of producing a large opening in the stomach which cannot be closed easily and accurately without considerable deformity is also obviated.

Duodenal ulcer. The duodenum is exposed by the same kind of abdominal incision as in resection of gastric ulcers. Its mobilization is accomplished by dividing bands of adhesions to neighboring organs and by ligating whatever blood supply on its anterior border is necessary. Partial ligation of branches of the pancreaticoduodenal vessel may be made without harm. By delivering the pyloric half of the stomach on the anterior abdominal wall and making slight traction on it, the exposure is increased. The duodenum is caught on the distal side of the ulcer with Allis clamps and steadied by an assistant. The ulcer is excised by being included in two semilunar incisions, the ends of which join. The upper incision is placed so that its middle lies opposite the center of the pyloric ring with its convexity upward; the lower incision is similarly placed, but with its concavity upward. These incisions encircle the ulcer and outline the amount of bowel to be sacrificed. They extend merely through the peritoneal coat. When this step has been carried out, the lumen of the duodenum is opened by extending the incision through its muscularis and mucosa. Any bleeding vessels are caught, as the incision is extended, and ligated with fine catgut. At this point in the operation, inspection very often reveals another ulcer on the posterior wall. This ulcer is generally just below that fold in the mucous membrane where the gastric mucosa is changing to the duodenal type (Figs. 3 and 4). The ulcers are seared with a cautery and their surfaces sutured over with interrupted catgut sutures. The closure of the anterior duodenal wall is accomplished in layers. The mucous membrane is closed separately and accurately, and a single suture of catgut inverts the seromuscular coat. Interrupted tension sutures of silk are optional. Should the pyloric muscle seem more spastic than normal, its division at right angles to the pylorus is advantageous and requires no change in the subsequent technique (Fig. 5 and 6). It will be found that there is not only no narrowing of the gastroduodenal stoma, but often an increase in its size. It has never been necessary to supplement this operation with a posterior gastro-enterostomy because of pyloric stenosis. The convalescence in these cases has been unusually smooth and free from vomiting and other distressing sequelæ. When this mode of operation has been used, the reduction of the acidity of the contents of the stomach in the first 2 weeks following operation has been found to average just one-half that noted in gastro-enterostomized patients. It should be borne in mind that the duodenal cap has been excised, and subsequent roentgenograms will reveal the same deformity as was found in original ulcer.

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CITRATE VERSUS UNMODIFIED BLOOD TRANSFUSION

A Report of the Comparative Results in a Series of Forty Consecutive Cases Transfused by Each Method; with Special Reference to the Occurrence of Reactions[1]

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REACTIONS following transfusion have been the subject of much investigation and discussion. Although many explanations have been offered for the occurrence of this phenomenon, no one has applied in every instance. Since the introduction of tests whereby the human race is grouped according to the effect of serum on red blood cells either by selection according to group or by mutual matching for compatibility, a certain percentage of reactions have been eliminated.

Mellon and his co-workers have shown the variability of the chemical reaction of commercial sodium citrate. This variation offers a very suggestive explanation. It is the writer's purpose to present the results derived from a study of 40 consecutive cases transfused by the citrate method as compared to 40 cases transfused with unmodified blood; the second series immediately following the first. Reactions are referred to by many authors. Mild ones and severe ones have been described, but in the literature available no precise definition can be found. In order that there may be no misunderstanding of the results herein incorporated, the writer advances as a working definition the following:

A reaction consists of a sharp rise in temperature, accompanied or unaccompanied by subjective or objective symptoms, not attributable to any cause except the transfusion. In the cases transfused by the citrate method, many types of reactions were noted. In most cases the reaction was initiated within 45 minutes after the procedure by a severe prolonged chill which at times was so violent that the bed trembled as the patient shook; accompanied by cyanosis, chattering teeth and rapid pulse. In some instances the chill was mild and of short duration and all patients complained of mental distress. Following the chill there was usually a rise of temperature averaging to between 102–103°. High rises were also encountered, the maximum in one case being 107°. Milder reactions, such as headache, palpitation, and nausea or vomiting unaccompanied by chills were present in a smaller percentage.

A critical study of the charts was made in order to include in the summary offered below any cases which presented any one or any combination of the above symptoms. In other words, only those cases were included as having no reaction in whom there developed no mental or physical symptom that did not exist before transfusion. Bearing in mind the above definition of reaction, a far better understanding of the entire subject can be arrived at, and it is with this idea that the following results are presented.

Table I illustrates the contrast between the occurrence of reactions following the citrated blood and the unmodified blood transfusion methods, respectively. Of 47 cases, 23, or 49.5 per cent, reactions followed the citrate method of administration. In 49 unmodified blood transfusions, no reactions occurred. The highest rise of temperature was to 100.8°, the temperature in some cases being recorded at two-hour intervals. At no time did new symptoms develop, attributable to the transfusion.

TABLE I.—CONTRAST BETWEEN CITRATED AND UNMODIFIED BLOOD

	Modified blood (citrated)	Unmodified blood	Total
Number of cases	40	40	80
Number of transfusions	47	49	96
Number of reactions	23—49.5 per cent	0	..
Extremes of quantities transfused	200 and 500 c.cm.	200 and 1020 c.cm.	

The nearest approach to the results described in this communication has been obtained by Lindeman who reports 214 transfusions by his method which were not followed by a chill. His cases, however, were followed by rises in temperature and other symptoms. In our cases there was complete freedom from any symptom. To offer an explanation for the absence of reactions is not easy. The perfection of technique employed in the citrate transfusions compared favorably with that used in the unmodified method. The method of selection of donors was identical. In order to approximate the conditions in the citrate method as nearly as possible to those of the unmodified blood method, the following routine was adopted: The blood was not

[1] Read before the Medical Society of County of Kings, Brooklyn, New York, December 19, 1922.

allowed to stand in the container any longer than it was necessary to transport it to the patients' bedsides and administer it. During transport and administration it was kept warm. These conditions were lived up to as closely as was compatible with human effort. In spite of all these precautions, reactions followed the citrate transfusions as frequently as before.

It is common knowledge that one of the most important requisites necessary for the avoidance of unpleasant sequelæ is the selection of a proper donor. All textbooks and most publications on the subject of matching donors describe and recommend grouping. As far as the recipient is concerned, we disregard this method of selection of donors. We recognize the four groups and prefer to rely upon the direct admixture of blood of the donor and recipient as the criterion of selection (mutual testing) rather than the identification of the group of the recipient and transfusion from an homologous donor. The mutual method of testing used is based upon that originally described by Rous Payton. It is done by calling to the laboratory four prospective donors, each a representative of one of the four groups. Blood is taken from the recipient's vein and mixed with 3 per cent sodium citrate solution in the proportion of one part o citrate to nine parts of blood. Two test tubes are taken for each donor. The donor's finger is pricked, 3 per cent sodium citrate solution is aspirated to the "1" mark on a white blood pipette, and the remainder is filled with blood. The contents of the pipette are then expressed into one of the smal test tubes and thoroughly mixed; the mixture is then again aspirated to the "1" mark in the white pipette, that fraction is expelled into another test tube, so that one test tube contains one part of blood and the other nine parts of blood. The white pipette is then thoroughly rinsed with water followed by citrate solution. It is next filled with the recipient's blood—nine parts of this is expressed into the tube containing one part of the donor's blood, the remainder, consisting of one part, is expressed into the tube containing nine parts of the donor's blood. In this way each one of the four donors is tested. After thorough shaking, the blood is allowed to stand at room temperature for 10 minutes and is then examined on a slide with a cover glass, under the microscope, at the end of which time agglutination, if present, can be detected quickly and easily. In none of the series reported was the transfusion followed by any symptom referable to incompatibility. This applies as well to all cases where tests have been done for transfusion not included in the above series. In no instance has there been failure to supply a compatible donor at the first testing of the group of four. In other words, there has been uniform success in securing donors by testing a member of each group by this method, in every instance with satisfactory promptness.

Before this method was adopted, it was not uncommon to prolong the time from the request for transfusion to its performance, for as many as two or three days until a donor who matched could be obtained. Furthermore, the writer's experience has been that although group tests identified donor and recipient as members of the same group, on direct matching agglutination occurred. It is accepted that Group 1, Jansky, or Group 4, Moss, members are universal donors whose red blood cells are not agglutinated by the other's serum. We have observed, however, in a number of cases by mutual match definite and marked agglutination, so much so, in fact, that transfusion from such a donor was not attempted. This opens a field for future study which it is intended to investigate.

Before leaving the subject of testing, it might be well to call attention to a condition which, though troublesome, can be, in our experience, disregarded with safety, i.e., autoagglutination. In two instances in our series we have found that agglutination occurred in the two tubes of each donor, that is, in the eight tubes under observation. Investigation revealed that a mixture of the patient's washed red blood cells with her own serum (both patients being females) showed marked agglutination. This phenomenon has been described in the literature and has been known to give rise to severe anæmia. Both patients were critically ill and upon consultation with the surgeon it was decided to risk the danger of hæmolysis intravitam. Group 1, Jansky, donors were used in both instances with highly satisfactory results; both patients recovered from the transfusions without a reaction, and also, from the diseases for which they were transfused.

One cannot emphasize too strongly, care in testing donors for agglutination. Not only may unpleasant symptoms follow due to carelessness in testing and disregard of hæmolysis, but fatalities may occur during the performance of or soon after the transfusion. With ordinary care, in our experience, at least, reactions and untoward results can be entirely eliminated. This applies as well to retransfusion. It has been emphasized by Libman, Ottenberg, and others that repeated transfusions from one donor may give rise to the production of hæmolysis, which, unless the recipient and donor are tested before each trans-

fusion, may easily be overlooked. Therefore, it is not safe to use a donor who proved compatible on one occasion, a second time, without retesting.

The method of election for the performance of the transfusion should be compatible with the experience of the operator and the environment. The general principle that the more closely the blood introduced into the recipient approximates the blood in its natural condition is a fundamental one. No matter how simple and how easy a method is, if that method permits of changes in the blood due to the admixture of foreign substances, to changes in reaction or temperature, to biological alterations in morphology (coagulation) and to ferment action, it is a departure from this principle. For this reason, the ideal method is that one which permits the blood to be transported from one individual to another quickly, and in as nearly a natural state as possible without operative mutilation to either recipient or donor.

In administering unmodified blood by the above described method, no foreign substance excepting the initial 3 or 5 cubic centimeters of normal saline solution are given to the patient. One is lead, therefore, to the almost unanswerable conclusion that the complete freedom of reactions was due to the administration of pure blood and that the reactions in the former method were due to the added sodium citrate.

It follows, therefore, that wherever possible, the transfusion of unmodified blood is preferable. Many methods have been described and many instruments devised to accomplish this end. Direct transfusion, that is, anastomosis from blood vessel to blood vessel, the blood coming in contact with no foreign substances in its transit, has been discarded as an obsolete method, yet only recently Horsely published the results of fourteen transfusions by this means. The direct method should be heartily condemned for at least three important reasons. First, it is a mutilating operation, as the blood vessels must be exposed; second, there is always danger to a donor when his tissues come in contact with the recipient's (particularly in the infectious diseases); third, one never knows how much blood the recipient is getting or if he is getting any at all.

Many practical instruments have been recommended whereby the blood can be transferred rapidly and efficiently from donor to recipient. Lindeman's method accomplishes it by interchanging numerous syringes with which he aspirates the blood from the donor and then injects the blood into the recipient. Unger uses a very popular instrument with a three-way valve. The transfusions have been performed by means of one of the Miller instruments; first, with the shuttle, and more recently with the valve. The valve is the simplest and more consistent instrument for this purpose. By this method but one assistant is needed, with very little paraphernalia and a transfusion of 500 cubic centimeters can be completed easily within 10 minutes. The method, in short, consists of the introduction of a Nc 18 Kaliski needle into the median basilic vein of the recipient and a No. 15 needle into the donor's vein without incision, the slipping on of the valve, the injection of 3 or 4 cubic centimeters of saline into each vein to insure patency, then aspirating, shifting the valve and introducing. It is imperative in order to insure success of the procedure, that the operator shall have had constant experience in entering veins. Incision and exposure of veins were not resorted to except in three cases, in an infant and in two moribund adults. The patients were moribund and the circulation was in such a state of collapse that the veins could not be distended and entered without exposure.

The transfusion of modified blood should only be done when it is impossible to administer unmodified blood—such conditions never arise in a well equipped hospital. The writer fully agrees with Bernheim in condemning the citrate transfusion for hospital use.

It is true that patients at times seemed too sick to be moved to the operating room where unmodified blood transfusions can best be done. We have overcome this difficulty in one of two ways; either by doing the transfusion at the bedside without moving the patient, or moving him with great precaution. The surgeon does not hesitate to move a patient to the operating room for a surgical procedure under the most desperate conditions and such conditions are no exception for transport for transfusion.

It is always well, after initiating the transfusion to inject carefully the first 40 or 50 cubic centimeters of blood slowly, meanwhile watching the patient carefully for the development of anaphylactic symptoms. These consist of sharp excruciating pain in the back, slight dry cough, and dyspnœa, the pulse as a rule giving no indication of the advent of this phenomenon. The transfusion must be discontinued, if such symptoms appear. In their absence, however, the blood may be injected more rapidly, the rate depending upon the general condition of the patient, particularly upon the cardiac and pulmonary status. With this method, under proper and average conditions one should be able to

transfuse at least 1000 cubic centimeters of blood without changing syringes.

The reasons for transfusions should be as clearly indicated as are the conditions for all operative procedures. The fact that a patient is desperately ill or is dying, and every medical and surgical resource has been exhausted does not necessarily indicate transfusion. At the same time transfusion has been instrumental in literally pulling a patient out of the jaws of death. A glance at our statistics, Tables II and III, will emphasize this fact. The most satisfactory results were obtained in cases of hæmorrhage which include those of obstetrical, postoperative and hæmophiliac origin, and also the anæmias, either primary or secondary. A number of these cases were almost moribund and their response to the infusion of blood was short of miraculous. It might be mentioned that in none of these cases were massive transfusions given, as practiced by some authors. The maximum amount transfused at any one time was 1020 cubic centimeters in two cases of exsanguination. For purposes of convenient study the cases have been divided into three great groups, namely, sepsis, the anæmias, and hæmorrhage. The sepsis cases were the most hopeless. They included bacteræmic conditions, postpartum sepsis, etc., with a mortality in 26 cases of 53 per cent.

The anæmias include those of the primary Addisonian type, and those accompanying malignancy, in addition to secondary types of varied origin. The statistics in this group are favorable, when we consider that some were done in cases preparatory to operation for extensive surgical procedures, and in cases where the best that might be hoped for was a remission of symptoms or a slight prolongation of life. The mortality in this group in spite of the unfavorable outlook was 29.6 per cent in 27 cases.

The best results have been obtained in the hæmorrhagic conditions. Postoperative shock has been included in this group because of the difficulties in differentiating it from hæmorrhage. Most of this latter group occurred after gall-bladder surgery, and on investigation were found to be a combination of both. The deaths that occurred in this group were cases in which the symptoms developed within 12 hours of operation. Transfusion temporarily relieved symptoms, but the patient died a short time afterward. Those cases which developed signs of hæmorrhage several days after operation, invariably showed immediate improvement, and recovered, although a few needed retransfusion. If we deduct the eight cases of postoperative shock, the results are very impressive, in that but 3 of 20 cases died, a mortality of 15 per cent. Many of the cases were desperately ill, some almost exsanguinated.

It is true that we cannot with any degree of surety state that transfusion saved the lives of all the cases that recovered. That transfusion in many of the cases acted as a contributory factor toward improvement or recovery cannot be questioned. And, in studying the individual records, and after reviewing individual cases, certain ones stand out in which transfusion turned the tide of life from the open sea of death and landed the patient safely upon the shores of the living.

TABLE II.—END-RESULTS IN 89 CASES TRANSFUSED

	Per cent	Cases
Recovered	38.75	31
Improved	16.25	13
Unimproved	7.50	6
Died	37.50	30
Transfused in moribund condition		4
Death possibly accelerated by transfusion		1

TABLE III.—TYPES OF CASES TRANSFUSED—WITH END-RESULTS

	Rec.	Imp.	Unimp.	Died	Total
Sepsis					
Postpartum	7	..	..	7	14
Surgical	3	1	..	2	6
Bacteræmias	..	2	..	1	3
Miscellaneous	..	1	..	2	3
Anæmia					
Primary	..	4	1	2	7
Secondary	3	3	1	..	7
Malignancy	1	2	..	1	4
Pre-operative	1	1	1	4	7
Miscellaneous	..	..	1	1	2
Hæmorrhage					
Hæmophilia	3	..	..	..	3
Postoperative	4	..	..	..	4
Obstetric	3	..	..	..	3
Uterus (fibroma)	3	..	..	1	4
Gastric (ulcer)	1	1	..	2	4
Miscellaneous	1	..	..		1
Postoperative shock	1	..	..	7	8
	31	13	6	30	80

It is true that we cannot with any degree of surety state that transfusion saved the lives of all the cases that recovered. That transfusion in many of the cases acted as a contributory factor toward improvement or recovery cannot be questioned. And, in studying the individual records, and after reviewing individual cases, certain ones stand out in which transfusion turned the tide of life from the open sea of death and landed the patient safely upon the shores of the living.

SUMMARY

Post-transfusion reaction is defined as a sharp rise in temperature, accompanied or unaccompanied by subjective or objective symptoms, not attributable to any cause except the transfusion.

Reactions followed in 49.5 per cent of 47 cases transfused by the citrate method, as compared to no reactions after 49 unmodified blood transfusions. Mutual testing for incompatibility is preferable to blood grouping.

TREATMENT OF DISLOCATED SEMILUNAR CARPAL BONES[1]

By GEORGE G. DAVIS, M.D., F.A.C.S., Chicago

UNTIL recently, as a rule, the treatment of a dislocated semilunar carpal bone might be summed up in three words—"take it out." More recently, however, a rather conservative therapy has entered the field and a more persistent effort is made at reduction.

In discussing the treatment we might divide the cases into three groups: Group 1, in which the dislocation is diagnosed immediately. This group is treated by manipulation. Group 2, in which the dislocation has not been diagnosed for a number of weeks or months or where the dislocation has not been reduced by manipulation. In this group, the open reduction with the use of a "semilunar skid" should be the procedure of choice. Group 3 comprises old cases which have not been diagnosed or have refused operation, or having been dislocated for a year or more, open operation has failed. In this last group and only in this group, it seems that the semilunar bone should be removed.

In using the term "dislocated semilunar bone" we may include cases in which the semilunar bone itself really is in position with its radial articulation in contact with the radius, but the os magnum with the rest of the hand is dislocated to the dorsal surface of the os semilunare (Fig. 4); and also, of course, we may include cases of true dislocation where the os semilunare is displaced from its articulation with the radius, its concave surface facing the palm of the hand and its radial articulation surface in contact with the os magnum, which now articulates with the radius (Fig. 10).

In the first group of cases, that is, where the diagnosis of a dislocated semilunar bone has been made immediately following the injury, we have been able to accomplish a reduction by a manipulation that may be termed the "broom stick method." This is merely the application of "Gunn's law" in reduction of the dislocation with the aid of the sawed-off end of a broom stick. Gunn called attention to the value in the treatment of dislocations in placing the dislocated member in the position it was at the time of injury and reversing the force.

In analyzing the force producing this dislocation, it is constantly found that the hand is pushed in a dorsal flexion position, that is, the force is directed from palmar to dorsal hand direction. A second force is exerted by the muscles and ligaments going from the forearm to the hand, pulling the hand toward the arm. The position of the hand at the time the dislocation is produced is that of extreme extension.

Hence according to Gunn's law, to reduce the dislocated semilunar the hand would be placed in extreme extension. One reversed force to be employed would be from the dorsal to palmar direction, that is, flexion of the wrist, and a second and simultaneous reversed force would be a pull on the hand to overcome the tension of the muscles going from forearm to hand. But this generally is not sufficient to reduce the dislocation, as the semilunar bone is loose and able to move with the flexion of the hand.

Therefore, to prevent the os semilunare from turning with the flexing hand, the curved surface of the side of a broom stick handle is placed at the lower tip of the os semilunare on its radial articulation aspect (Fig. 3). Thus the upper end of the os semilunare is pushed back into place and its concave surface engages the os magnum. The pull on the hand in a distal direction in-

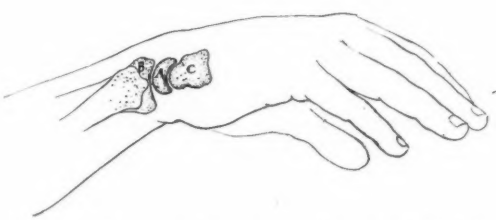


Fig. 1. Diagram showing the normal relationship of *a*, the semilunar bone, to *b*, the radius, and *c*, the os magnum.

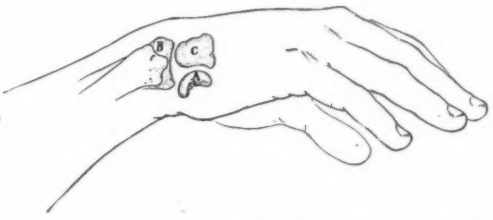


Fig. 2. Diagram showing the relationship of *a*, the dislocated semilunar bone, to *b*, the radius, and *c*, the os magnum.

[1] Read before the joint session of the American Association of Railway Surgeons and Association of Chicago, Milwaukee & St. Paul Railway Surgeons, October 19, 1922.

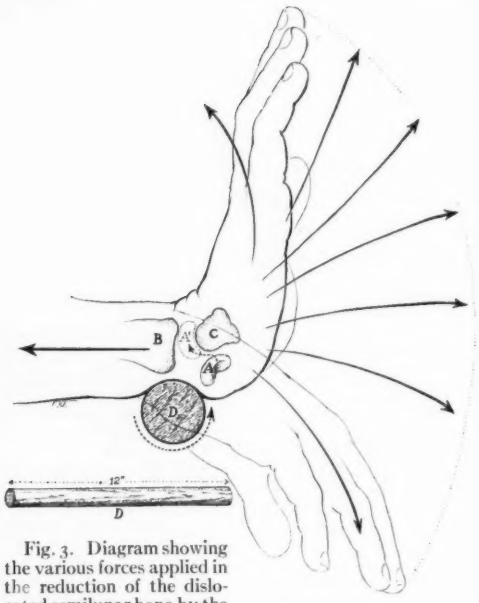


Fig. 3. Diagram showing the various forces applied in the reduction of the dislocated semilunar bone by the *d* "broom stick end method." The arrows indicate the direction of the various forces applied.

creases the space between the radius and the os magnum, making room enough for the os semilunare to return to its place as the hand is flexed. Case 1 (Fig. 4) was reduced by this method.

J. D., 39 years old, on August 4, 1921, received an injury to the left wrist causing a dislocation of the os semilunare and a simple fracture of the tip of the radius. After a roentgenological examination the diagnosis was made the same day that the injury occurred. On the following day, August 5, 1921, under an ether anæsthesia, an attempt at reduction with the "broom stick handle method" was attempted. A roentgenological examination after the operation showed a complication that may happen by this method. The lower palmar end of the os semilunare was pushed too firmly by the broom stick and the os semilunare was turned to the palmar aspect of the os magnum (Fig. 5). However, a second manipulation under ether with less force applied with the broom stick allowed the bone to fall into its normal position (Fig. 6).

When this method fails, which is generally the result where the case has not been diagnosed early or the patient has refused operation and months (8 to 12) have elapsed, then an open operative attempt at reduction should be made.

In this open reduction the writer has found it convenient to use a skid for the reduction of the dislocated semilunar carpal bone. The skid herein described is not new in principle as applied in fractures of the long bones. It is designed to overcome many of the difficulties experienced in open reduction of the dislocated semilunar bone, especially in cases in which the dislocation has existed over an extended period.

In the open operation with incision over the dorsal surface of the wrist, the operator finds several obstacles confronting him. There is but

Fig. 4. (Case 1.) Roentgenograms in lateral and anteroposterior views showing the os semilunare to the palmar aspect of the os magnum, yet its normal articulation with the radius is preserved.

Fig. 5. (Case 1.) Roentgenograms in lateral and anteroposterior views which were taken after the first attempt at reduction with the "broom stick method," showing incomplete reduction.

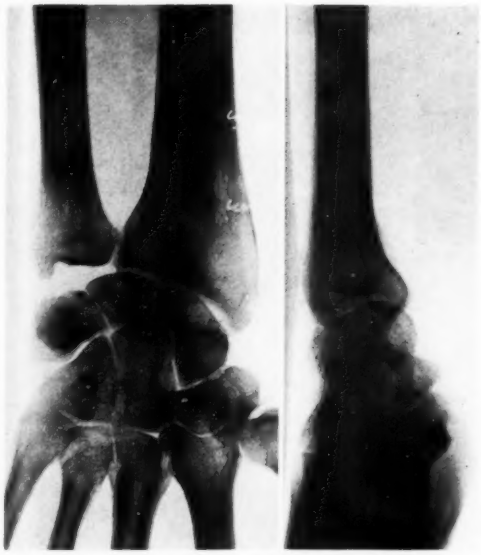


Fig. 6. (Case 1.) Roentgenograms in lateral and anteroposterior views taken after second attempt at reduction with "broom stick method," showing complete reduction.

little space between the articular surface of the radius and the os magnum, which articulates with the radius when the semilunar is dislocated. With flexion of the wrist and traction on the hand and counter traction of the arm, the space between the two bones is increased, but not enough for reduction of the semilunar bone, and the operator now finds himself embarrassed for a suitable instrument to pull or pry the semilunar back into place. There is no instrument in the general surgical armamentarium to meet this special need. A clamping instrument intended to pull the semilunar will damage the bone by crushing. A straight or single-curved instrument applied between the os magnum and the semilunar for the purpose of prying the semilunar into place crushes the os magnum.

It is on account of this difficult approach to the semilunar and the resulting injury to the carpal bones that the majority of textbooks recommend the removal of the bone rather than the reduction It is to overcome this difficulty and to save the bone that the "semilunar skid" is designed.

The skid, which is made of nickel steel, is curved on the flat surface (Figs. 7 and 8), and is thin enough to slide between the closely wedged bones. The upper border of the semilunar articulation surface which normally articulates with

Fig. 7 (above). "Skid" for reduction of dislocated semilunar bone—view from above and the side. The instrument is 8 inches in length and tapers from ½ inch in width at the middle to ¼ inch at the end, and varies in thickness from $\frac{3}{16}$ of an inch at the middle to $\frac{1}{16}$ at the tip. It has an S-shaped curve at the end. The distal curve, ¼ inch in length, a large arc of a small circle, is to receive the tip of the semilunar bone; the proximal curve, ½ inch in length, a small arc of a large circle, is to receive the os magnum.

Fig. 8. Lateral view of "skid" showing the two parts of the S-shaped curve; the distal curve for the tip of the semilunar bone and the proximal curve for the os magnum.

the os magnum (Fig. 1 and 2), slides to the volar surface of the os magnum when the semilunar is dislocated. To get the upper border of the articular surface up and back and to apply pressure enough on the os magnum to allow the semilunar to skid back into place, the "semilunar skid" is well adapted (Fig. 9). The distal curve of the skid engages the tip of the semilunar and the proximal curve skids over the os magnum.

Though the dislocation has lasted a number of weeks, or even months (Figs. 10 and 11, and 12 and 13), the reduction with the use of the "semilunar skid" can be accomplished without injury to the bones.

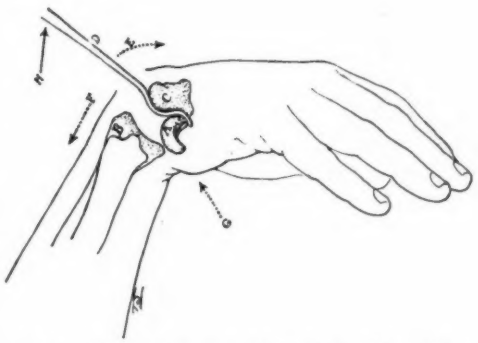


Fig. 9. Diagram showing, *d*, the "skid" and its relationship to, *a*, the dislocated semilunar bone, *b*, the radius, and *c*, the os magnum. The arrows mark the direction of the various forces applied to accomplish the reduction of the semilunar. The force applied to the handle of the "skid" is directed distalward and dorsalward; the force applied to, *c*, the os magnum and hand is directed distalward and toward the volar surface (flexion of the wrist); *f*, counter extension is applied to, *b*, the radius (and arm); *g*, pressure applied to the volar surface of the wrist, directed against the semilunar bone.

Fig. 10. (Case 2.) Roentgenograms in lateral and anteroposterior views showing dislocation of os semilunare.

CASE 2. V. S., a boiler maker, on May 25, 1922, received an injury to his left wrist. There was a chipping fracture of the ulna and radius. He had also at that time, a dislocated semilunar carpal bone which was not diagnosed (Fig. 10). On July 12, the diagnosis of a dislocated semilunar was made, that is, 7 weeks after the dislocation.

Fig. 11. (Case 2.) Roentgenograms in lateral and anteroposterior views showing the os semilunare in proper position after reduction by the "skid" method. The dislocation had been present for 8 weeks.

The "broom stick method" was tried in this case and failed. On July 20, or 8 weeks after the dislocation, the

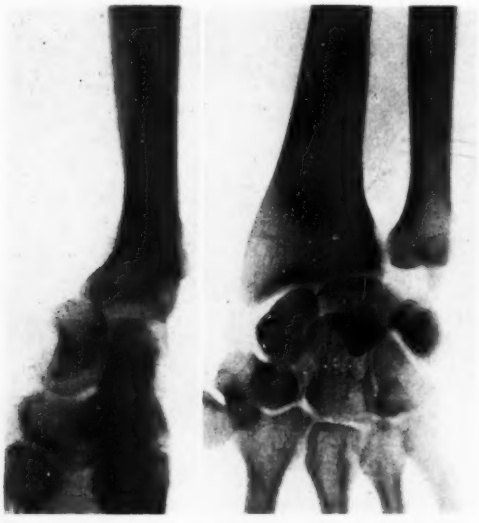


Fig. 12. (Case 3.) Roentgenograms in lateral and anteroposterior views showing dislocation of the os semilunare, which was not recognized at time of injury.

Fig. 13. (Case 3.) Roentgenograms in lateral and anteroposterior views showing the semilunare in proper position after reduction by the "skid method." The dislocation had been present for 3 weeks.

Fig. 14. (Case 4.) Roentgenograms in lateral and anteroposterior views showing dislocation of the os semilunare.

Fig. 15. (Case 4.) Roentgenograms in lateral and anteroposterior views showing fragments of the os semilunare remaining when the bone was removed after an unsuccessful attempt at reduction. The dislocation was of 21 months' duration.

open method with the use of the "skid" was employed and the semilunar bone was readily reduced and good function of the hand has resulted (Fig. 11).

CASE 3. R. F., a miner, received an injury on September 4, 1920, and a dislocation of the semilunar bone resulted (Fig. 12). This, however, was not diagnosed at the time. The diagnosis of a semilunar was made about 3 weeks later and on September 27, the open operation with the "skid" was performed and a successful reduction of the semilunar was accomplished (Fig. 13). This patient, seen some months afterward, showed an excellent functional result.

In the third group of cases where the dislocation has remained for 6 months or a year without a diagnosis being made and without an attempt at reduction having been made, the chances are poor for a return of the os semilunare to its normal position with a functional result. However, the open reduction with the use of the "skid" should be attempted.

If a reduction then can not be accomplished it is advisable to remove the bone by an anterior incision rather than to endeavor to take it out through the usual dorsal incision employed in the open reduction, as it is very difficult to remove it *in toto* by this route, and a fragment left in may cause considerable disability in the flexion of the hand, as noted in one of the writer's cases.

CASE 4. A. G., a roofer, received an injury to his right wrist on July 14, 1919, and a fracture of the radius was diagnosed, but the dislocation of the os semilunare was overlooked. It was not until April 17, 1921, or 21 months after the injury, that the diagnosis of dislocated os semilunare was made (Fig. 14). The open reduction with a posterior incision and the use of the "skid" was attempted in this case. It was found that the os semilunare was bound down by dense adhesions and it was impossible to slip it into its normal position. An endeavor was made through this posterior incision to remove the bone. The bone was broken into pieces in this endeavor and portions removed. On roentgenological examination following the operation, it was found that a number of pieces of bone was left on the palmar aspect. The patient refused a second operation to remove these portions of bone. The result was not good. There was a loss of function due to these remaining portions of bone. In such cases, therefore, it would seem advisable, when an endeavor has been made to reduce the os semilunare by the posterior incision and the reduction is impossible, that a better policy would be to make a new incision upon the palmar aspect of the wrist and remove the bone by that incision.

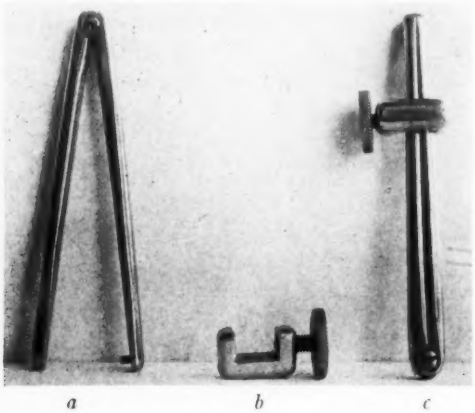
INTESTINAL CLAMP WITH DETACHABLE HANDLE

By LINCOLN DAVIS, M.D., F.A.C.S., Boston

THESE clamps were devised for use in the operation of excision of the rectum by the combined abdominoperineal method with establishment of permanent colostomy in one stage.

The instrument consists of a strong hinged clamp with longitudinally grooved blades 4 inches long (Fig. 1, *a*). The backs of these blades are grooved to permit the application of the small locking clamp with thumb screw (*b*) by means of which the clamp is held firmly closed, and slipping prevented. A pair of strong clamp handles with ratchet lock, whose blades are shaped to enclose and hold the blades of clamp (*a*) by means of slightly flexible clips completes the instrument (Fig. 2).

The clamps are used as follows: the blades, held as in *a*, Figure 3, are applied to the intestine at the point selected for resection. Two pairs are applied across the intestine parallel to each other with an interval of a quarter of an inch of intestinal wall or less between the two sets of blades. The handles are then set up and firmly locked, the intestine severed with the cautery between the blades, the tissue being charred down to the surface of the clamp, completely sterilizing the field. The small locking clamp is then applied to the middle of the intestinal clamp blades and set up by means of the thumb screw (*b*, Fig. 1), the handles are then removed (*c*, Fig. 1).



a *b* *c*

Fig. 1.

The proximal clamp is brought out through the colostomy wound, the clamp being opened after 48 hours. The distal clamp is dropped down into the pelvis with the freed up portion of gut to be removed, and the toilette of the pelvic peritoneum completed above it; the rectum and sigmoid are then removed from below by the perineal route, the clamp acting as a guide.

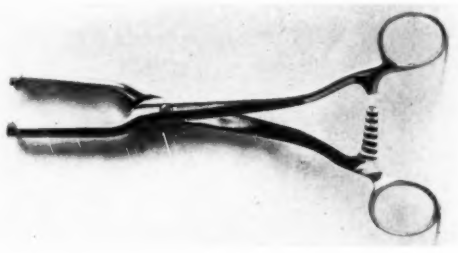
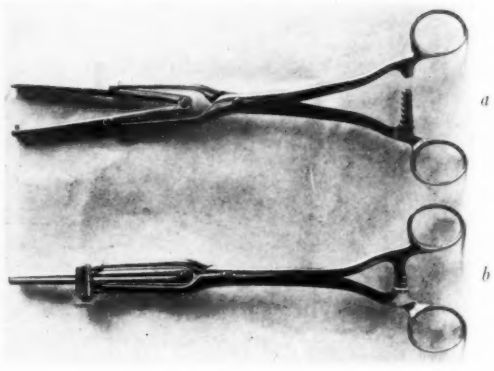


Fig. 2.



a

b

Fig. 3.

The advantages claimed for these clamps are (1) that they permit of severing the bowel in an aseptic manner, with the expenditure of a minimum amount of time; (2) after removal of the long handles the locked clamp blades may be conveniently passed through a small colostomy wound, or temporarily dropped into the true pelvis.

I have found the instrument useful in a number of cases.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

AUGUST, 1923

CAUSE OF THE HIGH COST OF HOSPITAL CARE

THE Lincoln is the ideal motor car. Therefore, all doctors should attend their patients in such a vehicle and charge the overhead to the patient. We are following this principle now in hospital construction and we will perhaps get around to the standardization of the automobile a little later. Hospital architects are building artistic palaces in which they reserve some spaces where patients can be kept. The products are ideal. For the common people, however, ideality is merely a state of mind, not a reality to be achieved.

It has been aptly stated that only the rich and the indigent can get the best medical and hospital care. Here is one of the fundamental reasons. The high cost of the hospitals means not only the great initial cost but, what is of more importance, the increased upkeep. The public can usually be induced to build the hospital, but once it is finished they assume the task is finished; those who are responsible for the conduct of the hospital know the work has just begun. The final burden rests, however, on the pay patient. If he cannot pay he must be treated at home. An ideal hospital is one which achieves its purpose. Palaces for the rich are quite in order, but it should be remembered that good hospital care can be provided in buildings of low cost and small overhead. They may lack many things desirable, yet they achieve a great good. The ideal Christmas tree is one so small that the children can reach the candy. The small community hospitals are reaching the needs of people of moderate means more efficiently than the palatial institutions because they are within reach of the average citizen. The most of us reach our daily task with the aid of an automobile of low initial cost. It is not ideal but we get there on time just the same, provided we start early enough, and at a tremendous saving of the overhead. Those who have to do with the standardization of hospitals do perhaps not fully appreciate the limitations of the purse of the average citizen.

Material equipment is often too much stressed. The reason is that this is easy to do. The effort required is less than the standardization of the more human factors. There might be no criticism of this were it not that it has as result the education of the public to the belief that the kind of hospital determines the product. It is a common thing for a group of doctors to assure the public that the building of a hospital would bring with it efficient medical service. This is education in the wrong direction. It takes the responsibility from the medical profession, where it belongs. A patient is better off in the kitchen with a surgeon than in the best appointed operating room threatened by an operator. Medical talent, not palatial hospitals, is the need.

ARTHUR E. HERTZLER.

DIVERTICULA OF THE URINARY BLADDER

A STUDY of the indices of medical literature during the past decade shows a gradually increasing number of articles relating to conditions formerly considered to be of rare occurrence. The development of more accurate means of diagnosis, of the roentgenogram in particular, is showing not only that these conditions are not rare, but also that to their existence are to be ascribed signs and symptoms which formerly were either not understood or were wrongly interpreted.

Among such conditions which are now known to be of fairly frequent occurrence are included those structural anomalies of the urinary bladder known as diverticula. It is only within comparatively recent years that the existence of these pouches which develop in the wall of the bladder has been generally recognized, only five cases having been reported in the United States previous to 1906. With the development of cystoscopy and of cystography, however, it has become possible to diagnose with certainty the number, location and size of these diverticula, for they may be single or multiple, may occur in any portion of the bladder and may vary in size from a small pocket, which barely admits the tip of the finger, to a sac the capacity of which is equal to that of the entire bladder cavity. A diverticulum may have a fairly wide opening, or it may communicate with the bladder by a very small opening, thus simulating a pedicled tumor in its roentgenographic outline. In the diagnosis of this condition, therefore, close co-operation between the urologist and the roentgenologist is essential.

There is a difference of opinion among urologists as to the etiology of diverticula, that is, as to whether they are congenital or acquired. In the light of E. M. Watson's observations, however, it seems probable that there is a congenital predisposition to their formation, but that "their clinical recognition during adult life is hastened and their dimensions greatly increased by any of the factors that would bring about increased vesical distention or increased activity of the bladder musculature." This opinion is strengthened by the fact that diverticula nearly always occur in males in whom also the urinary outlet is more frequently obstructed.

Diverticula present no specific symptoms. Their presence should be suspected, however, in any case in which difficulty of urination, frequency, and pyuria exist as concomitant conditions, and wherever there is persistent pyuria especially after repeated irrigations. Any abnormality of micturition should be an indication for a cystographic examination of the bladder which should include an anteroposterior plate and at least two plates taken from different angles.

It is obvious that once a diverticulum becomes infected, no medical treatment can be effective. Irrigations may be palliative, but in many cases the diverticulum cannot be irrigated as contractions of the bladder will often close its opening. It follows that the only curative treatment is complete removal.

There is a difference of opinion as to the best method of diverticulectomy but the writer's experience has been that a large diverticulum can be most readily removed after first packing it with gauze or cotton so as to convert the sac into a semi-solid tumor. The entire sac can then be readily dissected free from the surrounding tissues, its attachment to the bladder severed, and the opening in the bladder closed. In closing the diverticulum opening in the bladder, the mucosa should be turned in and sutured so as to leave a slight ridge rather than a depression on the inner surface of

the bladder as a depression would cause a tendency to recurrence.

A small diverticulum which can be readily picked up with forceps and drawn within the bladder is satisfactorily removed intravesically.

Any cause of obstruction which may be present—enlarged prostate, stricture, cicatricial contraction of the vesical neck, etc.—should be remedied to prevent recurrence of the diverticulum. If a ureter opens into a diverticulum, as frequently happens, it should be transplanted.

In view of the almost uniformly satisfactory results of diverticulectomy and the inevitable progress of the ill effects due to the presence of diverticula, operation should not be delayed once their presence has been determined by the aid of the cystoscope and the roentgenogram.

W. E. LOWER.

MASTER SURGEONS OF AMERICA

WILLIAM STEWART HALSTED

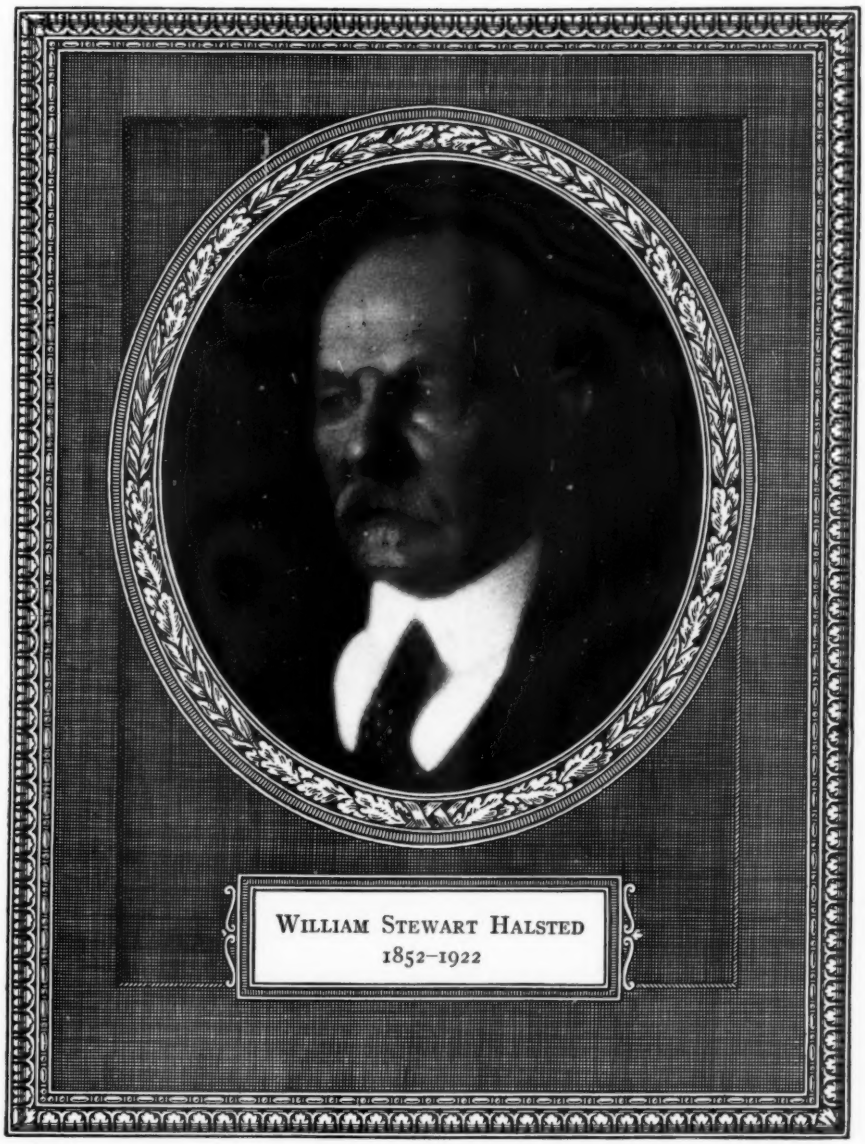
William Stewart Halsted, M.D., Sc.D., LL.D., Hon. F.R.C.S., F.A.C.S., Professor of Surgery in The Johns Hopkins University and Surgeon-in-Chief to Johns Hopkins Hospital, was born in the city of New York on September 23, 1852, and died in Baltimore on September 7, 1922.

Dr. Halsted was of English ancestry, descended from a family prominent in the social, business, and philanthropic life of New York. He was the son of William M. Halsted, Jr., and Mary Louisa Haines Halsted.

Dr. Halsted prepared for college at Phillips Academy, Andover, Massachusetts. He was graduated from Yale University with the A.B. degree in 1874. He studied medicine in the College of Physicians and Surgeons, now a department of Columbia University, and was graduated in 1877 at the head of his class, for which he received the first prize of one hundred dollars. He served as surgical interne and later as house surgeon in Bellevue Hospital from 1876 to 1878. He was the first house physician in the New York Hospital where he served for a short period in 1878, leaving this service to go abroad where he studied for 2 years, chiefly in Vienna, Leipzig, and Wuerzburg. Upon his return to New York he was made assistant demonstrator of anatomy in the College of Physicians and Surgeons, and later became demonstrator of anatomy, which position he filled with great distinction until 1885.

He began the practice of surgery in the fall of 1880. From the beginning he limited his practice to surgery, and in all probability was the first in this country to confine himself exclusively to this specialty. About the same time he was appointed attending surgeon to Presbyterian and Bellevue Hospitals and assisting attendant surgeon to Roosevelt Hospital. He was also chief surgeon to the dispensary of the latter hospital from 1881 to 1886. In addition to all this he was surgeon-in-chief to the Emigrant Hospital, Ward's Island; attending surgeon to the Charity Hospital, Blackwell's Island; and substitute attending surgeon to Chambers Street Hospital.

Upon his return from Europe in 1880 Dr. Halsted organized a corps of teachers called a "quiz," for the purpose of higher medical education. None but graduates of first-class colleges was accepted. Associated with him in this work were such men as Frank Hartley, George M. Tuttle, William G. Thompson, George E. Munroe, and West Roosevelt. All of the teachers in this quiz had hospital



WILLIAM STEWART HALSTED
1852–1922

appointments and hence could give the students dispensary, bedside, and laboratory instruction. As an evidence of the thoroughness with which the instruction was given by this able corps of instructors headed by Dr. Halsted, of the last class graduated from this quiz eight were on the honor list of ten in the College of Physicians and Surgeons, and of the first twelve in the graduating class that year ten were from this quiz. Thus his subsequent contributions to the science and art of surgery as author, investigator, teacher, and trainer of men were but the natural fulfillment of the early promise exhibited in his brilliant achievements during this busy period of his career in New York.

As a direct result of the character and extent of his work during this period, his health suffered and he was compelled to relinquish his work for a time. His health having improved, Dr. Halsted, in 1887, came to Baltimore as one of that brilliant coterie of men who had been attracted thither by the unequalled opportunities offered in the newly opened Pathological Laboratory of the Johns Hopkins University under the inspiring leadership of Dr. Welch. Here he became at once identified with, and a leading spirit in, the new Johns Hopkins School of Scientific Medicine. In the early days of this development he was associated with such brilliant pupils of Dr. Welch as Mall, Councilman, Nuttall, Walter Reed, Abbott, Flexner, and many others of like mind. No wonder then that Dr. Halsted, with his splendidly trained mind, his scientific curiosity, and his wide experience and interest, developed rapidly in this congenial atmosphere and was not long in embarking upon that career of unrivalled productiveness along all lines of surgical progress that has marked his connection with The Johns Hopkins from beginning to end. Here he founded a school of surgery, based upon the most approved scientific principles, the distinguishing characteristics of which were honesty of purpose and thoroughness in method. It is impossible thus early to appraise at their true value the various elements that contributed to raise Dr. Halsted to the high position that he undoubtedly occupied in the surgical world. The proper perspective is hardly possible so soon after the close of his remarkable career. But to those who were privileged to serve under him, to benefit by his inspiring leadership, his wise counsel, and stimulating example, the one thing that stood out with greater prominence than anything else was his earnest search after and his passionate love of the truth. Everything else was subordinated to this. It made no difference whether or not the truth, when finally discovered, confirmed or overthrew his preconceived ideas or previously enunciated theories. His absolute honesty made him always the first to call attention to his own mistakes. The painstaking care, however, with which his work was planned and the scientific accuracy with which it was performed made this rarely necessary.

Dr. Halsted has expressed himself upon more than one occasion as convinced that the best result of his arduous labor was the development of a group of younger surgeons trained under him in modern scientific methods, and thoroughly

imbued with the same high ideals of surgical honesty. Among all of his contributions he personally attached greatest importance to the law discovered and enunciated by him in connection with the investigations of the action of parathyroid autografts in the dog, namely, "that unless considerable deficiency in parathyroid tissue has been created, the autografts do not live."

From the first publication that appeared under his name, the report of a case of intestinal incarceration operated upon by him, appearing in the *Medical News*, January 27, 1883, surgical literature has been continuously enriched by the many thoughtful and erudite studies that have come from his laboratory. This was truly his workshop, for the clinical side of his work interested him comparatively little, although all of his publications had a very practical application, many of them pre-eminently so, for example, his introduction of the use of rubber gloves in surgery, his insistence upon the most meticulous care in the gentle handling of tissues, absolute asepsis, complete hæmostasis, etc.

Personally, "The Professor," as he was familiarly called by his staff, was a curious mixture of contradictions; abnormally shy and sensitive as a woman; to a stranger reserved to a degree; and yet to his few intimates the most charming of companions; endowed with a keen yet kindly sense of humor, and at the same time with a wit that upon occasion could be caustic in the extreme. To his associates and assistants he was always stimulating and helpful, even if at times he may have felt it necessary for their good to apply the Biblical adage, "Faithful are the wounds of a friend."

Dr. Halsted was in the truest sense of the term a Master Surgeon. There was nothing that concerned either the science or the art of surgery that did not hold something of interest for him. While his natural bent inclined rather toward the science than the art of surgery, still the list of his contributions covers pretty much the entire range of both phases of the subject. The number of his publications reaches well over a hundred, all valuable and many original pieces of research, and some epoch-making, e.g., his work upon the radical cure of cancer of the breast and of inguinal hernia, nerve blocking, etc.

Dr. Halsted has, by the wide range and excellent character of his work, given prestige and renown to American surgery and earned the right to have his name enrolled among those of the great immortals. To scientific surgery, to the institutions with which his name has become inseparably connected, to his pupils and friends who enjoyed the inestimable privilege of his inspiring companionship, his death means an irreparable loss.

"Now is the stately column broke,
The beacon's light is quenched in smoke,
The trumpet's silver sound is still,
The warder silent on the hill."

J. M. T. Finney.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 16, 1923, DR. HENRY F. LEWIS, PRESIDING

SPECIMEN SHOWING FASCIA BETWEEN PELVIC ORGANS

DR. JOSEPH B. DE LEE: The specimen I present to you shows beautifully and clearly the various layers of the pelvic fascia. You have heard mentioned several times in our meetings the fascia that exists between the bladder and uterus. I never knew that it could be so beautifully dissected.

The specimen shows how the organs of the pelvis, the bladder, vagina, and rectum can be dissected absolutely free from the fascia surrounding them, leaving thick layers of connective tissue. If I should remove the lining membrane of these hollow viscera the fascia would still present their shapes. I show you the rectum with the fascia belonging to it. The bladder is dissected from its investing capsule or fascia, and this particularly I wish to bring to your attention because that is the fascial layer which we reduplicate in the low cervical cæsarean operation. The specimen was presented to me by Professor Tandler of Vienna.

In his collection I saw a specimen in which the levator ani muscles were attached to the so-called white line. I saw other specimens in which the levator ani muscles were attached below the white line, and in one of them it was one-half inch above the white line.

The origin of the levator ani is not constant in the human female. In discussing it with Professor Tandler he told me that sometimes the levator ani extended as far back as the spine of the ischium That was the point of contention between Dr. Barrett and myself the last time we discussed this subject. The levator ani may be inserted one-half inch below the spine of the ischium.

These differences we clinicians have not appreciated in the past, in consequence of which they have led to all sorts of acrimonious discussion.

Another point: Professor Tandler, as an anatomist, has done a great deal of work on the pelvic organs, and he has an interesting theory regarding the causation of prolapse. He says the levator ani as it curves from the coccyx around and up behind the rectum and down toward the anus forms a beautiful S-shape, which curve is destroyed during labor. In the normal human being the cervix slips back into the hollow made by the coccyx and the curves of the muscle. When the fetal head comes down and destroys the hollow, it straightens out the levator ani, and the cervix slides down the straightened muscle. This theory is very beautiful and was borne out by some of the specimens he was able to show me.

BACTERIA IN THE BLOOD VESSELS OF CHORIONIC VILLI; HYDATIFORM MOLE

DR. J. P. GREENHILL: The patient, a primipara, 15 days overdue, who had been given castor oil and quinine three times without avail, was admitted to the Chicago Lying-In Hospital for induction of labor. A bougie was inserted into the uterus but failed to stimulate pains. The next day a Voorhees bag was introduced and after 6 hours of labor pains, was expelled spontaneously. The cervix at this time was dilated only 6 centimeters. There was a cessation of pains, which did not recur until the following day, during which pains were irregular. On the evening of the third day, the temperature rose to 102.4° and the pulse to 116. Because of the elevation of temperature, acceleration of pulse, and irregularity of the heart tones, it was decided to deliver the patient, which I did by means of Kielland forceps after making incisions in the cervix. The child had three loops of cord around its neck, but it was easily resuscitated. The patient had a severe postpartum chill and a temperature of 105°, but both mother and baby made a good recovery. Because of the evident intrapartum infection in this case, we immediately put in formalin for study, the placenta, which had a foul odor. Sections were made by Dr. Serbin, our pathologist, and we found clumps of bacteria not only in the maternal but also in the fetal portions of the placenta. On the fetal side, bacteria were found not only in the stroma of chorionic villi but also in the blood vessels of the villi. We thought we had made a discovery because not one of the men to whom the sections were shown knew of any one who had ever demonstrated bacteria in the vessels of chorionic villi.

A thorough review of the literature, however, disclosed the fact that three men had demonstrated bacteria in the vessels of chorionic villi. Schmorl in 1904 demonstrated tubercle bacilli in the villous vessels; Hellendall in 1906 demonstrated pyogenic organisms in the vessels; and Warthin in 1907 demonstrated tubercle bacilli. Under the microscope you will see an area showing bacteria in the

stroma of a villus and within the blood vessel of the villus. Other areas show bacteria in the decidua. There is, however, no evidence of inflammation in any of the sections.

I should like also to show a specimen of hydatidiform mole *in utero* which I removed from a patient who was referred to me because of an acute toxæmia. She was 12 weeks pregnant and had hypertension, albumin and casts in the urine, and œdema. She also had a mitral and aortic insufficiency and exophthalmic goiter with symptoms. She complained bitterly of a constant headache and persistent vomiting. She had had two children normally, both living. Most of the pathological anatomical findings were attributed by the patient to a previous severe attack of tonsillitis. Because of the severe acute symptoms she presented, it was decided to terminate pregnancy and perform sterilization. An abdominal hysterotomy was performed and on opening the uterus a few vesicles appeared. Since sterilization was to be performed anyway, a hysterectomy was done. The uterus corresponded in size and consistency to a 12 weeks' pregnancy, as you may see, and there had been no discharge of blood or vesicles at any time. The patient made an excellent recovery. Nearly all the abnormal symptoms disappeared quickly after operation.

DISCUSSION

Dr. Joseph B. De Lee: I would like to ask a question in connection with the case reported by Dr. Greenhill. A physician referred a patient to me from out of town, saying she had had an hydatidiform mole which he removed with the finger and followed it by curettage of the uterus. This physician suggested that I perform a hysterectomy as a prophylactic measure to prevent the development of chorio-epithelioma. According to the literature, he said, chorio-epithelioma occurs in from 33 to 50 per cent of all cases after hydatidiform mole, and in view of this high percentage of chorio-epithelioma following hydatidiform mole, this practitioner thought it would be wise to extirpate the uterus to prevent such an occurrence. I told him my opinion was different. I have had 20 or more cases of hydatidiform mole, and not one of them to my knowledge has come back with chorio-epithelioma, and I, of course, refused to take the uterus out in such a case.

I would be glad to hear the experiences of members of the society who have had cases of chorio-epithelioma following hydatidiform mole.

Dr. Emil Ries: I was called down state to testify as expert in a case where a doctor was accused of murder. The case centered around an abortion of a young woman who came to the doctor's office to consult him while aborting an hydatidiform mole. He sent her home and in the presence of the family he removed the hydatidiform mole. She died and was buried. Somebody caused an investigation. Her body was exhumed, the uterus taken out, and found clean. The uterus was presented to an expert in Chicago, the author of a textbook on gynecology, and this expert stated she could not have had an hydatidiform mole because she did not have chorio-epithelioma—the same mistake which has been mentioned here tonight. Because one case of hydatidiform mole is followed by chorio-epithelioma, it does not mean that every case of hydatidiform mole will be followed by chorio-epithelioma. Two of the experts in this case had read in books that chorio-epithelioma quite frequently developed in cases where there had been hydatidiform mole, and they agreed that the woman could not have had hydatidiform mole because it was not followed by chorio-epithelioma.

By showing up this erroneous conclusion the freedom of the doctor was secured at once.

Dr. Arthur H. Curtis read a paper entitled "The Diagnosis and Treatment of Sterility; A New Procedure."

BLOOD PRESSURE IN THE NEWBORN FOLLOWING NORMAL AND PATHOLOGICAL LABOR

Dr. Ralph Reis and Dr. Arthur J. Chaloupka contributed a joint paper (by invitation) entitled "Blood Pressure in the Newborn Following Normal and Pathological Labor." (See p. 206.)

DISCUSSION

Dr. Arthur H. Curtis: This paper bears the stamp of individuality and is worthy of great commendation. I am sure I voice the sentiments of the members when I say we have greatly enjoyed having Dr. Reis with us.

Dr. Joseph L. Baer: The work presented by Drs. Reis and Chaloupka represents a tremendous amount of painstaking effort and is therefore worthy of commendation aside from the actual merits of the results obtained. The question as to the practical value of their results will come out in a future series of cases on which they are going to work.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 3, 1923, DR. FREDERICK G. DYAS, PRESIDING

MEGACOLON IN CHILDREN

Dr. Vernon C. David read a paper entitled "Megacolon in Children." (See p. 197.)

DISCUSSION

DR. DEAN LEWIS: I should like to say a word about the case which Dr. David reported and which I saw. This boy, 4 years old, had never had normal bowel movements. He had worn a diaper because of a continuous discharge from the rectum. When I saw the X-ray picture, I thought that a good deal of the obstruction was due to the falling forward of the upper part of the sigmoid at the ampulla, and if I could resect that I might enter the abdominal wall. I resected the sigmoid and sutured with a modified Mikulicz, suturing the line extraperitoneally, and opened it on the second day. Dr. David started on the valve formation, which was about the position of the mucocutaneous junction or a little higher. The operation was done in January, 1921. I closed the colostomy on October 28, and the boy has been having normal bowel movements since. I think he has had daily evacuations of the bowel without any apparent obstruction. He has been on a regulated diet. I supposed the valve was the primary etiological factor in the megacolon, and that the fixation of the colon to the abdominal wall to prevent falling forward of the sigmoid at the ampulla had something to do with it.

I operated on another case 7 years ago which had been seen by Dr. Senn. At that time the patient had a fairly large bowel. She was 38 years of age, and gave a typical history of megacolon. An interesting thing was that it was associated with a neuroenteric cyst, the size of a grapefruit, in the hollow of the sacrum, and containing cerebrospinal fluid. In this case I extirpated a part of the cyst. I opened the cæcum on account of obstruction. It is now 7 years since the operation was done. I saw her on October 28, last. She has to take enemas to evacuate the bowel; otherwise she is fairly comfortable without any great dilatation. She has never had regular bowel movements since the operation. In her case I did an end-to-side anastomosis between the ascending colon and the rectum. If I remember correctly, I took out the sigmoid and transverse colon and did an end-to-side anastomosis, but as I have said, she has never had a normal evacuation of the bowel. However, she gets along fairly well with the use of enemas. No valve formation has been demonstrated in this case.

DR. E. WYLLYS ANDREWS: The type of congenital deformity Dr. David spoke of is closely allied to the ordinary imperforate anus. In imperforate anus we find a blind pouch below and above another fold; sometimes these are 3 or 4 centimeters away from each other, with a large bridge of tissue which has to be spanned somehow. In such a case one can make a puncture with the bistoury to find the length of the muscle or other tissue from the blind pouch below to the pouch above, and introduce a tube.

The abnormity Dr. David has mentioned is not so very rare, as I have seen five or six such cases.

DR. JOHN NUZUM presented a paper on "Experimental Production of Carcinoma in a Dog's Breast."

DR. A. J. OCHSNER read a paper on "Cancer Infection."

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD APRIL 6, 1923, DR. FREDERICK G. DYAS, PRESIDING

SYPHILIS OF THE STOMACH

DR. GATEWOOD: It is not very often that we have the opportunity of following up our cases of syphilis of the stomach. As it happens, there is in town today a man, who, I feel quite sure, had syphilis of the stomach. I am glad to have the opportunity of presenting him tonight. This man consulted my brother 3 years ago last August, giving a history, at that time, of losing weight for 6 months. He then weighed about 108 pounds. The most important point in his history was vomiting immediately after meals. He had gotten so that he could take but little when he swallowed, 5 or 6 ounces being the maximum. He was on an entirely liquid diet. Physical examination at the hospital showed very little except marked emaciation. The laboratory findings were these: the Ewald showed no free hydrochloric acid, total about 14; no blood in the stomach contents or stools; hæmoglobin 62 per cent with the blood picture otherwise negative. X-ray showed a very marked defect in the stomach which I will show you on a slide, and this defect involved most of the stomach wall. The Wassermann was 4 plus. He gave no history of an initial lesion. He is the father of four children, and there is no history of miscarriages. The findirgs, then, were achlorhydria, a stomach defect, an inability to eat. He had obstruction in the duodenum beyond

the outlet, somewhere in the retroperitoneal portion. This was not marked and was only a part of the clinical picture. A pre-operative tentative diagnosis of syphilis of the stomach was made upon the deformity and upon a 4 plus Wassermann. At that time it was not deemed advisable to continue the therapeutic test for any length of time, because in spite of all that could be done he continued to lose in weight. I operated on him, doing a gastro-enterostomy. I found a stomach which at no place was wider than my three fingers. It was œdematous and had a glassy appearance throughout. He had stellate scars on the liver with the typical picture of syphilis of the stomach.

After operation he was given the benefit of antiluetic treatment, and he has gained from 108 pounds back to 140, his normal weight being 132 pounds before. He is doing the work of a section hand on a railroad and apparently is in excellent health.

URETHRORECTAL FISTULA

DR. T. J. SULLIVAN, SR.: A urethrorectal fistula is a condition that is not often met with in general surgery for most of these cases go to the genito-urinary man. The reason for presenting this operation tonight is to show my modification of an old principle in treating such cases. I recognize the splendid work by Hugh Young, published in SURGERY, GYNECOLOGY AND OBSTETRICS, and by Dr. Harvey B. Stone later on, published in the *Journal of Urology* in 1917 and 1921 respectively, reporting a new method of operating which differs from anything previously shown and giving good results in fourteen cases.

The technique which I have worked out is based upon a principle which was described in 1902 by Paul Segond. I shall say nothing about operations performed previous to that time.

In dealing with complete laceration of the perineum in the female, Paul Segond maintained that a better operation can be done by dividing the scar, passing up on the rectum and dealing with the torn rectum down to the verge of the anus, thus shutting off contamination of the wound and closing the perineum over the rectum. I have often used this method, and I applied the same principle to this case and succeeded in securing primary union.

Urethrovesical fistulæ are in many cases the result of operations for the removal of vesical calculi. That was the cause in this patient who had been operated on more than 20 years ago. Such fistulæ may also follow operations upon the prostate. Severe trauma and infective inflammations may also cause these fistulæ. The first cause mentioned, however, is the most common.

The first step in operating on these cases is preliminary cystotomy. In our case there was a preliminary cystotomy was performed and drainage of the bladder instituted to maintain a clean field. When this was done the patient was put in the Trendelenburg position and a stab was passed through the urethra and into the bladder. A cross incision was made to expose the perineum; the rectum was uncovered and drawn down as it is in the operation described by Paul Segond. This makes it possible to dispose of the fistula in the rectum and to have a clean field attached so as to build the perineum afterward.

SYPHILIS OF THE STOMACH

DR. KARL A. MEYER read a paper entitled "Syphilis of the Stomach." (See p. 127.)

DISCUSSION

DR. W. A. BRAMS: There are a few points in connection with syphilis of the stomach to which I desire to call attention. These points are best illustrated by citing two cases, one of which shows the advisability of giving very intensive syphilitic treatment in cases of supposedly inoperable carcinoma of the stomach. This patient was observed on the service of Dr. Bensaude in Paris, the patient being a man 55 years of age, who suddenly developed copious hæmatemesis; vomited about a pint of blood without ever having had any gastric disturbance. For 2 years following that he had vague digestive symptoms, consisting largely of nausea, constipation, and loss of about 25 pounds in weight. Two years after the first hæmatemesis he had another attack. Later he was taken to the hospital; the abdomen was rigid and no palpation could be made. Bleeding was profuse so that no gastric analysis could be made. Eventually a mass was felt in the abdomen and a diagnosis of carcinoma was made; but the condition was considered inoperable, and as a last resort mercury was given to him by injections. The condition cleared up. An instructive part is the X-ray examination of the stomach right after hæmatemesis. The X-ray examination before treatment showed complete absence of the pyloric part, and after specific treatment, lasting for several weeks, the pyloric portion of the stomach gradually returned, according to the fluoroscope, and after a few months the pyloric portion was complete and showed normal motility. We received a letter from him 2 years later in which he stated he was in good health and had gained 50 pounds in weight and had no more gastric distress.

While the case may not be considered as proved syphilis of the stomach, the probability is in favor of that diagnosis.

In another case a diagnosis of syphilis was made but it was not syphilis. The patient, a male, had suffered from epigastric pain after meals for 8 months. He was a waiter by occupation; he had a mass in his abdomen and a 4 plus Wassermann. He, too, was considered as having carcinoma of the stomach at first, and in 5 days died. Autopsy showed a stomach which had five superficial ulcerations which at first were considered syphilis. But on making a cut section of the stomach wall it was at once seen that the case was not syphilis. The submucosa was not thickened. None of the changes

described here were present. Vascular involvement was not present. Pan-phlebitis and pan-arteritis were absent. There was not even an extensive lymphocytic infiltrate.

A careful review of the literature was made and of all cases reported in the domestic and foreign literature, and we selected 135, which we considered reliable and with sufficient information upon which to base a presumptive diagnosis of syphilis. Of these 135 cases, 14 were anatomically proved, and the 2 reported tonight makes a total of 16.

There are four varieties of gastric syphilis, depending upon the underlying pathology: the ulcerative type; tumor or gumma; the leather-bottle type, and the stenosing type. It is hardly necessary to go into more detail. In the stenosing type the pylorus and cardia may be involved in the same individual.

In studying the symptoms of these 135 cases it was found that pain was the most important symptom of all. It was present in all but 3 cases and came on after meals. There was a marked subacidity; in 93 reports there was marked anacidity or subacidity. Marked emaciation was present in 88 per cent, the average loss of weight being 35 pounds. The fact that the patients had so much emaciation and anæmia leads to the suspicion of their having syphilitic cachexia, and not a malignant cachexia. Eight cases showed evidence of lues, and in 96 the Wassermann was positive. In 9 additional cases there were undoubted signs of lues. Sixty per cent of the cases were clinically cured with specific treatment; in 30 per cent there was marked improvement, and in 7 per cent of the cases there was failure. Einhorn reports a case of anacidity which returned to practically normal after treatment. In one case I mentioned at first there was a return of the pylorus to normal as seen on X-ray examination.

The X-ray reports vary as to the findings. One cannot say that there is a definite picture of syphilis of the stomach on the X-ray plate. The nature of the findings will depend upon the nature of the pathology. If there is a tumor or a gumma it may look like a carcinoma, and if there is stenosis it will look like a stenosis.

Other less important symptoms are hæmatemesis, vomiting, constipation, and tenderness, and enlargement of the liver in the anatomically proven cases was found in the majority of them.

DR. ROGER T. VAUGHAN: It was my privilege to see this pyloric mass resected by Dr. Meyer, and I examined it immediately after removal. The society should not get the impression that Dr. Meyer recommends excising syphilis of the stomach. Not at all. At operation he found a mass in the pyloric end of the stomach with the glassy œdematous appearance of the serosa which Dr. Gatewood also noted in his case. The clinical findings were those of well-marked pyloric stenosis.

The diagnosis lay between carcinoma and syphilis of the stomach. We knew the woman had systemic, gummatous syphilis. She also had a large mass at and proximal to the pylorus and had enlarged glands along the lesser curvature. There was some hesitancy in deciding whether resection should be attempted or merely a gastro-enterostomy. Dr. Meyer asked my opinion and I agreed that it appeared logical to take it out. After the mass was resected I examined the opened surface of the gross specimen. The submucosa was markedly thickened and infiltrated. The ulcers had ragged margins and a granulomatous base. There were no raised, hard, infiltrated nodular edges as we see in epitheliomatous ulcers. The entire mass appeared to be a granuloma, but no caseous foci could be found. There was no reason to believe the patient had tuberculosis and we *did* know that she had active syphilis.

If this specimen is syphilis of the stomach, it is the only fresh case that I have seen; and if it is not syphilis, I do not know what it is. Certainly the microscopic findings are also highly suggestive even though the spirochæta has not been found.

I have seen a number of patients on whom there has been made the clinical diagnosis of syphilis of the stomach. When such patients recovered, the correctness of the diagnosis has usually remained a matter of dispute, but if they died and were autopsied they nearly always proved to have carcinoma of the stomach. A positive Wassermann is present in 10 per cent of the cases of carcinoma and ulcer of the stomach. Patients with carcinoma of the stomach may improve for a time under such tonics as arsenic and mercurials and appropriate dietetic management. A patient with syphilis of the stomach can also improve under routine ulcer treatment, much as does a peptic ulcer, and the recovery of patients with peptic ulcer is not hindered if arsenic or mercurials are added to the usual ulcer treatment.

It has seemed to me hitherto that clinical diagnoses of syphilis of the stomach have been by no means well founded.

I have seen no case in which has been applied the ultimate test to the diagnosis of syphilis of the stomach, namely, the finding of the treponema. It was not found in the case Dr. Meyer operated on nor in the case of Dr. Brams. It has only very rarely been found in cases of syphilis of the stomach, so far as I am familiar with the literature, and must be differentiated from spirochæta dentium, which is occasionally a surface saprophyte in achylous stomachs. The treponema is hard to find. In Arthur Curtis' case[1] endarteritis was a striking finding as well as the miliary gummata which we see here in Dr. Meyer's case, but Dr. Curtis, too, was unable to find the treponema.

If this case reported by Dr. Meyer is not one of syphilis of the stomach, I do not know what it is. Perhaps it is not necessary that the treponema should be found in order to confirm the diagnosis, since the treponema has also not been found in those cases which have come to autopsy. In view, however, of our present inability to apply this

[1] J. Am. M. Ass., 1908.

ultimate test with success to cases diagnosed gastric syphilis, scientific caution would appear to demand that we make this diagnosis tentatively and with the mental reservations which our present lack of confirmatory evidence makes necessary. In order to administer arsenical or mercurial preparations to gastric ulcer cases, however, only a reasonable suspicion of the presence of syphilis should be needed. Therefore, a positive Wassermann test or other signs of syphilis would appear to justify these additions to standard ulcer management; but a successful outcome subsequently does not prove that the gastric lesion so treated was syphilis.

DR. GATEWOOD: I have seen four cases of syphilis of the stomach which were as typical as the one I have described. The difficulties in doing a gastro enterostomy in these cases are considerable. On account of the marked œdema and submucous thickening a clamp should rarely be put on the involved portion of the stomach, making it necessary frequently to do a gastro-enterostomy without a clamp. This seems to make no difference because in each of these four cases the patient made a good recovery without leak. All four cases received antisyphilitic treatment after operation. Three of them at the present time are markedly improved or well, one having been operated on 6 months ago, one 3½ years ago and the third about 5 years ago. I have no recent report upon the fourth case.

DR. CARL B. DAVIS: I wish to report a case in which the patient was turned over to the surgical side with a diagnosis of cancer. After the abdomen had been opened a small, constricted stomach was seen that was quite suggestive of a condition known as "leather bottle." The possibility of syphilis of the stomach was discussed with the internist who was present at the time of the laparotomy. There were a number of slightly enlarged glands in the gastrohepatic ligament. One of these was removed for microscopic examination. It was impossible to decide at operation whether the linitis plastica was a carcinomatous infiltration of the entire stomach or whether the condition was syphilis.

Microscopic examination of the gland showed carcinoma.

DR. R. W. MCNEALY: I should like to ask why the treponema cannot be found. We know that it is found in other tertiary lesions. I would like to ask the authors if they have any reason to suggest for not finding the treponema.

In looking over the literature of blood-vessel surgery, I have found several instances in which spirochæta have been found at the vasovasorum in the vessels and demonstrated by several men.

DR. MEYER (closing): There have been reported cases in the literature in which the treponema pallidum have been found in lesions of the stomach. J. W. McNee in the *Quarterly Journal of Medicine*, April, 1922, reports and demonstrates the finding of spirochætæ in a resected ulcer of the stomach. Wile, of Ann Arbor, also mentions the finding of these organisms in the stomach mucosa. The possibilities are that as more cases are examined by serial sections, an increased number will show the presence of these organisms.

In answer to the question relative to the infrequency of the spirochætæ in gastric lesions, it may well depend upon the action of the gastric juice.

The reason for the extensive resection of the stomach in this case was due to the actual organic obstruction. I had observed this patient under the fluoroscope and during the period of three-quarters of an hour, no barium passed through the stomach into the duodenum.

It may well be that more cases of syphilis of the stomach are about than are ordinarily diagnosed. We should, however, not become too enthusiastic and diagnose every case of gastric ulcer showing a positive Wassermann as one of syphilis of the stomach. If we investigate our cases from an anatomical and pathological standpoint, we find that many cases of peptic ulcers, diagnosed as syphilis, are callous ulcers and have no luetic basis.

Dr. Charles Davison read a paper entitled "Adhesions of the Ascending Colon Simulating Chronic Appendicitis." (This article will appear in a later issue.)

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON SURGERY

THE busy practitioner, and no doubt in many instances the specialist, being so engrossed with his daily work, loses sight of many of the more interesting phenomena, from a physiological standpoint, which take place. He therefore loses not only a very important factor in his own viewpoint, but furthermore loses his scope of medical vision.

It is manifestly impossible for a busy man to keep himself informed upon all the newer advancements made in the basic branches of medicine. Another factor which no doubt further confuses the busy man is the more or less constant change of opinion on bacteriology, physiology, and the like. He is told one thing today, which is disputed tomorrow, and likely disproved on the third day. No doubt many men lose their courage in trying to keep abreast of medical progress and science as applied to medicine.

It is, therefore, of great interest to read the re-edition of the little volume by Short.[1] This volume deals with the newer physiology in surgical and general practice. In the first edition it was the author's intention to bring to the clinical man those new facts as applied to physiology, which had been more or less definitely established and proved, and which could be used as a basis for the study of clinical cases. In the present, which is the fifth edition, the author has in no way altered his position. There have been three more chapters added, and two chapters from former editions have been dropped out.

This little volume affords the most interesting reading, because it places before the reader's mind in a very logical and pleasing manner, many of the basic principles from a physiological standpoint which confront the practitioner, and which give him a distinctly new line of vision and open new avenues of thought. In contrast to most books of this nature, the subject matter is presented in a most interesting fashion, in such a way that one may read hours without becoming fatigued or bored.

The author does not attempt to present anything new to the profession, but simply to compile from the enormous amount of work done and the literature produced, those facts which he thinks are more or less stable and new, and which will be of value to the reader.

As an illustration, the first chapter, which deals with the physiology of muscular exercise brings many interesting points to the reader's attention, which, although they give us no basic explanation for many processes which take place, yet open up avenues of thought and stimulate in the reader's mind that which is more necessary than information—namely, the ability to think.

Furthermore, in the chapter devoted to the dietetic factors in causation of appendicitis, I do not believe the author attempts to state that appendicitis is caused by dietetic errors; nevertheless, after reading this chapter, one is convinced of certain rather unusual things and with this opinion as a basis for further thought the reader will be much the more enlightened.

The author does not attempt to cover the entire field of physiology, but, as stated in the preface, simply brings to the attention of the practitioner certain new phases of the newer physiology as it pertains to surgery and medicine.

The book can be heartily recommended to those men who wish to learn to think anew.

THE manner in which a living organism defends itself against destructive processes, has been a study which has always confronted the medical profession. As much as we may know about immunity at present, we must confess the question is more or less answered by calling certain intangible, vague things by names and assuming that they perform certain specific functions.

This statement is not made to belittle in any way many of the processes which have been discovered by the scientists. There is no doubt that many of these processes do take place in some manner or form, and that we must accept them at the present time until they are disproved. Nevertheless, it is very apparent that this whole subject must be most confusing to the student, even though he may have worked with the subject, both in its laboratory aspect and from clinical application, and he very frequently becomes lost in this labyrinth of cursory facts.

The presentation of this subject in a form which is simple, concise, and clear, is certainly invaluable to the student of medicine, and to anyone who wants an introduction to the subject. To the reviewer's mind, this is ideally met with in the little book by Jean Broadhurst.[2] It was a great pleasure to the reviewer to read this book from cover to cover, and there is no doubt in his mind that it is

[1] THE NEW PHYSIOLOGY IN SURGICAL AND GENERAL PRACTICE. By A. Rendle Short, M.D., B.Sc. (Lond.), F.R.C.S. (Eng.). New York: William Wood & Co., 1922.

[2] HOW WE RESIST DISEASE; An Introduction to Immunity. By Jean Broadhurst, Ph.D. Philadelphia and London: J. B. Lippincott &Co., 1923.

probably the best presentation of the subject which is brief, with which he has come in contact. The subject is discussed in stages, beginning with bacteria, their entrance into the body, their life cycle as affecting active and passive, immunity toxins and antitoxins, agglutinins, precipitins, opsonins, lycins, etc.

The subject matter of each chapter prepares the reader for a greater comprehension of the subsequent discussions. The value of this book lies not in presenting anything new, but presenting those more or less established principles in a manner which is understandable, readable, and clear. The book is invaluable to the student of medicine, to the nurse, either in training or in practice, and to a large group of medical men who should read it, not only from force of necessity, but for the satisfaction of acquiring certain definite knowledge.

THERE is considerable question in the reviewer's mind as to the value and necessity of a textbook of surgery. Many surgical teachers believe such a book is not only useful but indispensable. This attitude is no doubt justifiable so long as surgery is taught in many universities as it is at the present time. Nevertheless, it seems that in many medical schools a decided change is taking place in surgical pedagogy, and the reviewer is inclined to believe that sooner or later teaching from textbooks will become obsolete.

However, so long as students are taught the subject by getting their information from books, a textbook of surgery will be a necessity. In spite of the fact that there are many textbooks of surgery in the hands of the medical profession, some exceedingly well written, some mediocre, and some decidedly poor, it appears that the ideal book for teaching has not yet come to light. The fault probably lies in the fact that each surgical teacher has his own peculiar method of approaching the subject and does not confine his literary efforts solely to his teaching instinct, but tries to cover his subject in a more or less complete fashion such as would appeal to his own mind.

The re-edition of *Practice of Surgery* by Howard,[1] is, to the reviewer's mind, one of the best presentations of the subject we have today. The subject is covered in a very complete manner, and special emphasis is placed upon the fundamentals. The author states, in his preface to the first edition, that this work is the result of the request of many students to prepare a book which embodies so far as possible the surgical teaching given by the author in the London Hospital. There is no doubt but what he has accomplished his purpose.

In this, the third edition, the book has been brought up to date. The section on "Injuries of the Nerves," has been largely re-written. There have also been revisions made in the chapters devoted to the stomach, duodenum, and colon, in which he includes roentgenographic methods of diagnosis, his descriptions being brief but lucid. In many instances, especially in the discussion of regional surgery, the author tabulates his subject matter in such a fashion that one can, at a glance, grasp the salient divisions. This is very useful to the student, since these facts stand out as the important parts of the subject discussed and he can fix them in his mind much more readily. It obviates the common objection to most textbooks, namely, that the student reads the discussion and fails to grasp the essentials.

At the close of many chapters the author leaves blank pages for notes, which the student may insert from time to time thus completing his subject; a very desirable feature, in the reviewer's mind, for it enables the student to keep his notes with the original textbook.

Whatever opinion one may have regarding textbooks of surgery for teaching purposes, one must concede the fact that this book is unusually well written, and that the subject is so well presented that even the student must of necessity grasp the important points. The book is also of decided value to the practitioner who wishes information upon surgical topics without resorting to any unusual efforts. To the reviewer's mind, it is one of the best books upon the subject which is in our hands today.

THERE is no question but what the nurse who has a fairly comprehensive idea of surgery is more competent to take care of her surgical patients than she who has not. This knowledge should be general, comprising not only a knowledge of etiology and pathology, but symptoms and treatment as well, since with such knowledge, she can co-operate with the surgeon in charge much more efficiently and is capable and able to detect symptoms which she alone is in a position to observe.

A volume, therefore, which comprises those essentials of general surgery which would present to the nurse's attention these facts, is no doubt indispensable. McDonald, in his little *Manual of Surgery*[2] has accomplished this purpose in a satisfactory manner. The varied subjects are taken up very briefly but nevertheless the essential points are brought to the reader's attention in a simple, concise manner, giving the reader those facts which are basic and important.

Errors will creep into almost any work, and it might be well to call attention to the statement made under the paragraph entitled "Peripheral Nervous System," where it is stated that a paralysis of the fourth cranial nerve causes drooping of the upper eyelid.

This volume is written essentially for the nurse, and it fulfills its purpose adequately.

J. A. WOLFER.

[1] THE PRACTICE OF SURGERY. By Russell Howard, C.B.E., M.S. (Lond.), F.R.C.S. (Eng.). 3d ed. Philadelphia and London: J. B. Lippincott Company, 1922.

[2] ESSENTIALS OF SURGERY; A TEXTBOOK OF SURGERY FOR STUDENT AND GRADUATE NURSES AND FOR THOSE INTERESTED IN THE CARE OF THE SICK. By Archibald Leete McDonald, M.D. 2d ed. rev. Philadelphia and London: J. B. Lippincott Company, 1923.

THE fourth edition of this book was published in 1912, under the supervision of the original author, Sir F. W. Hewitt.[1] During the intervening 10 years the advance in the science of anæsthesia has made such progress that the entire text has been rewritten. This revision with the addition of that which is new upon the subject is presented in a concise, well arranged manner. The volume is of particular value to the medical student as well as to the specialist in anæsthesia because the interesting and informative subject matter is based upon years of clinical experience. Chapter IX deals especially with the pre-operative considerations—including the psychic element so largely neglected. There can be no controversion to a patient's truthful description of a crude induction of anæsthesia. The book is up to date with the exception of the experimentation of ethylene, which is of too recent a date to have been included. This edition is a valuable text and reference book upon the subject of anæsthesia.

A. L. BARTHOLOMEW.

IN the introduction, the author expressly states that this book[2] represents his own observations and research and is not a compilation of the opinions of others. In this respect it is refreshing, yet this same virtue makes it necessarily rather incomplete. The book is divided into sections, in which various diseases of the bones and joints are considered.

In the first section general considerations are taken up. The various structures entering into the formation of bone, and their reaction to inflammations of various kinds are studied. The author lays particular stress on the idea that the real site of all inflammation is in the marrow of the bone, and particularly in the lymphoid marrow. In the joints, the susceptible structure is the synovial membrane. All the other structures play only a passive part. In this section the subjects dealing with the healing of fractures, ankylosis, bone grafts, and arthroplasty are also considered, briefly, not to say sketchily.

In the second section, devoted to "Acute Osteomyelitis and Arthritis," the idea that the marrow is the tissue chiefly affected is further elaborated. The author takes the stand that trauma plays a very slight rôle in these conditions.

In section three "Chronic Osteomyelitis" is considered. In this many of the rarer forms, osteomyelitis fibrosa, leontiasis ossea, Paget's disease, syphilis, and rickets are taken up.

Section four is worthy of special notice. It is entitled "Chronic Arthritis." The author calls attention to the confusion in the classification of the chronic arthritides, and proposes to simplify it by dividing them into two great types which he calls simply the first and second great types. The first great type is that in which "there is a proliferative inflammation in the synovial membrane and in the bone marrow, with a resulting rarefaction or death of the bone and a perforation or death of the articular cartilage," i.e. a destructive arthritis. This includes tuberculous, streptococcic, and probably all the bacterial arthritides. The second great type is the proliferative type with new bone formation at the joint line. Further to simplify matters the author takes the ground that the first type practically always originates in the tonsils, deep urethra prostate, or seminal vesicles; the second type always originates in the alveolar process, or rather is associated with alveolar necrosis which may furnish a portal of entry.

The book is decidedly unorthodox in many conclusions, and being unorthodox is worthy of careful consideration. It is especially good for the amount of pathological study, that is for the careful study of the microscopic pathology of bone and joint conditions. The illustrations of these microscopic specimens are good. Treatment is rather scantily considered. Taken as a whole the book is rather hard reading but shows the evidence of study, and should stimulate thought, which is the hallmark of a good book.

B. H. MOORE.

THE *Manual of Surgical Anatomy*[3] by Beesly and Johnston is an extremely comprehensive textbook. Surgical anatomy is really after all only a review of those parts of anatomy which a surgeon must know. From this standpoint, the choice of material is excellent. Especially notable is the omission of the enormous mass of detail descriptive of ligations and amputations which encumbers so many of the works on surgical anatomy. On the other hand, the anatomy of the newer fields of surgery, especially joint surgery, is thoroughly treated.

The value of such a book is largely dependent on the illustrations. This book contains 166, many of which are semidiagrammatic and are for the exposition of special points. All of the illustrations are of the highest quality, and there are many plates. Many are modified from Cunningham's *Anatomy*. The authors have yielded to the desire to depict the unusual instead of the commoner forms of pathology, as exemplified by the roentgenogram of a case of tuberculous dactylitis in a child. The many plates of bones and joints in children are an excellent feature. Epiphyseal lines and centers of ossification are well shown, both in the normal and associated with fractures.

Unfortunately, the book is marred by too much technical description of surgical operations. Furthermore these sections abound in actual misstatements of facts. For instance, the method of performing a gastro-enterostomy, described on pages 302–3, is hardly the usual one. The site for the anastomosis is "preferably the most dependent portion of the

[1] ANÆSTHETICS AND THEIR ADMINISTRATION. By the late Sir Frederick W. Hewitt, M.V.O., M.A., M.D., 5th ed., edited by Henry Robinson, M.A., M.D., B.Ch. London and New York: Oxford Medical Publications, 1922.

[2] INFLAMMATION IN BONES AND JOINTS. By Leonard W. Ely, M.D. Philadelphia and London: J. B. Lippincott Company, 1923.

[3] A MANUAL OF SURGICAL ANATOMY. By Lewis Beesly, F.R.C.S. (Edin.), and T. B. Johnston, M.B., Ch.B. New York: William Wood & Co., 1923.

greater curvature"!! Atomy is also given as one of the indications for this operation. Another surprising statement appears on page 345, in a discussion of implantation of the ureters into the colon. "It might be supposed that the introduction of the ureters into a septic tube would lead to an ascending infection of the urinary tract, but, provided that urine, ureters, and kidneys are healthy there is no risk of such an occurrence." Again, on page 315, anastomosis of the gall bladder to the colon is recommended for common duct obstruction, and it is further stated that common duct obstruction causes a dilatation of the cystic duct.

However, the main part of the text, the anatomical descriptions, cannot be too highly praised. They are characterized by a brevity which might well be adopted by other anatomists, and at the same time there is no sacrifice of clarity. This fact alone should assure the success of this *Manual*. Finally it may be noted that the indexing is thorough and complete. EDMUND ANDREWS.

IN 1904, the prosectors of the faculty of the University of Paris began issuing a series of small volumes covering the operative technique of surgery in different parts of the body. Doctors Labey and Leveuf[1] have recently brought forth the fifth edition of the book covering surgery of the lower extremity. This little book is divided into three parts: first, surgery of the bones; second, surgery of the joints; third, surgery of the tendons, veins and nerves. In Part 1, the technique of the different forms of osteotomy is described as well as the technique used in introducing the Steinmann nail. Open treatment of fractures is given much attention, and the many types of operation, especially those on the femur, are given in detail, but the indications for operation are not mentioned. The treatment of patellar fracture is well illustrated. In part 2 we find a description of operations on joints, including drainage, resections, and arthroplasties, much attention being bestowed on the foot joints. In Part 3, surgery of the tendons is meagerly covered, as is also the subject of vascular lesions. In the section on nerve surgery, we find a description of operations on the important nerves of the lower extremity. The illustrations are clear and instructive, and while the information on the subjects covered is scant, it is definite and the book might well be used as a ready reference for the embryo surgeon. KELLOGG SPEED.

THIS single volume[2] is the work of two international authorities on orthopedic surgery. One is the leader in orthopedic thought throughout the world; the other, one of the leaders in American orthopedic surgery. Both are renowned teachers and thorough students. The book is authoritative, practical, and a valuable work for the student, the general practitioner, and the orthopedic specialist. It is too technical for the average student.

The authors have not attempted to make the work of an encyclopedic nature, and have, therefore, omitted methods which they consider obsolete or ineffectual. Much discussion of discarded methods is happily omitted. They have used their own wide personal experience as a basis of their discussion and it is of great value that each author gives his individual thought on many subjects,—this to be contrasted with that of the co-author. The methods of other authors are given and are well illustrated in many cases.

The method of teaching used is fundamental and employs the principle of association in an endeavor to use the process of thinking instead of the cultivation of memory.

The scope of orthopedic surgery as defined in this book is divided into six groups: (1) joints and their affections, (2) bones and their affections including ununited and malunited fractures, (3) disturbances of the neuro-muscular mechanism, (4) congenital deformities, (5) static and other deformities, and (6) the principles and details of apparatus.

In studying the numerous illustrations, one recognizes many old acquaintances seen in the former publications by the same authors. This is especially true in the chapters on scoliosis, infantile paralysis, and stiffness of joints. Many reproductions from Bradford and Lovett's book are used.

The authors have drawn freely from the works of numerous surgeons and have reproduced many classical operations, viz., arthroplasty of the knee-joint by Putti, operation for loose bodies in the knee-joint by Henderson, the Edwards operation to reconstruct internal and external lateral ligaments of the knee-joint, the Hey-Groves operation for ruptured crucial ligaments of the knee-joint and the Smith-Peterson operation on the sacro-iliac joint.

The Everidge method of aiding the patient's will power in moving septic joints by means of graduated passive movement is illustrated very well and is a valuable supplement to the practice of Willems. The descriptions of the mechanics and measurements of braces are very good. An excellent brace for round shoulders is illustrated but not described.

The frequent paragraphs on anatomy and physiology are excellent introductions to several chapters. The gross and microscopic pathological sections illustrated are excellent. PHILIP LEWIN.

[1] CHIRURGIE DU MEMBRE INFÉRIEUR. By Georges Labey and Jacques Leveuf. 5th ed. rev. Paris: Masson et Cie, 1923.

[2] ORTHOPEDIC SURGERY. By Sir Robert Jones, K.B.E., C.B., and Robert W. Lovett, M.D., F.A.C.S. New York: William Wood & Co., 1923.

AMERICAN COLLEGE OF SURGEONS

HEALTH SITUATION AND MEDICAL SCHOOLS OF LATIN AMERICAN COUNTRIES

By OSCAR DOWLING, M.D., New Orleans, Louisiana
President, Louisiana State Board of Health

I. HEALTH SITUATION

DURING the 1923 cruise of the American College of Surgeons facts were gathered concerning the health situation in fifteen cities of seven South American countries: Cartagena, Colombia; Caracas, Venezuela; Rio de Janeiro, São Paulo and Santos, Brazil; Buenos Aires, Argentina; Montevideo, Uruguay; Santiago, Valparaiso, Antofagasta, Mejillones, Iquique, Arica and Tacna, Chile; and Lima, Peru. Conditions in Havana, Cuba; Port of Spain, Trinidad; and the Canal Zone were also noted.

Figures show about the same percentage of tuberculosis, typhoid, smallpox, syphilis, gonorrhœa, and malaria as with us (except on the dry west coast and in a few places which have been drained). Considerable trachoma and leprosy exist, and in a few places, hookworm disease. The endemic tropical diseases are comparatively negligible as compared with those with which we are familiar. With the exception of a few cases of yellow fever in two cities of Brazil, where active measures were being taken similar to those followed in New Orleans in 1905, there was no plague, no cholera, and no yellow fever. Incidentally, it may be of interest to add that they have had no plague in Rio de Janeiro since 1910, and no yellow fever since 1907; in Buenos Aires, no plague for 5 years, and no yellow fever for 30 years. This is excellent evidence of effective control measures. The facts justify the conclusion that the health situation in the various countries is very similar to our own.

In some communities a large per cent of the babies die under one year of age. Commenting on this one of the leading papers said: "Ignorance is the chief cause of infant mortality. To control this, well-prepared nurses of intelligence and initiative are necessary to teach the mothers and the public." In almost every place visited the supply of good milk is very limited. Were this provided, with teaching by the intelligent trained nurse, the death rate among infants would be materially reduced.

Some of the outstanding impressions concerning communicable diseases are: Extreme precautions to prevent smallpox; compulsory vaccination, and maritime quarantine against this disease with strict enforcement of regulations. Other contagious diseases are controlled more or less effectually by methods similar to those in effect in the United States. The value of educational work and demonstrations of control are emphasized.

In Port of Spain, Trinidad, epidemic diseases are divided into dangerous and non-dangerous, and the dangerous cases are handled exclusively by the Government. In case of plague the house is burned and the owner is compensated.

Brazil is spending $2,000,000 in a hookworm eradication campaign, which appropriation is matched or added to by the Rockefeller Foundation.

It was interesting to note that in thirteen cities the water supply was brought from a distance—from the mountains, pure and wholesome, or from artificial lakes. The water supply of Rio de Janeiro comes from the mountains forty miles distant; sheds protect the water, making treatment unnecessary. The supply for Buenos Aires comes from the river fifteen miles above the city. The system is the same as that in New Orleans. In Lima, Peru, the water is from springs and is settled, filtered, and chlorinated; the system is now being rebuilt. In the little city of Mejillones, Chile, the water is condensed and sold by the railroad shops at ten cents for five gallons; in Iquique, Chile, a city of 40,000, the water is wholesome and abundant but expensive; they are hoping soon to have free water.

Modern methods of waste disposal were found in several cities. In Rio de Janeiro, sewage is treated chemically before it is emptied into the sea; in Buenos Aires the sewage is carried fifteen miles down the river and emptied below low water mark.

Incinerators are used to dispose of garbage, which is collected in covered wagons and carts. In Panama, under the direction of Dr. Henry Goldthwaite, the incineration of garbage, except certain light waste, has been abandoned because of expense and odors from the plant, and they now dump the garbage for filling purposes. The garbage is sprayed, to saturation almost, with a larvacide and then covered with a layer of bags or old carpets and over all three feet of earth. This earth is sprayed for ten days. By this means objectionable odors are avoided, flies do not breed, and rats are not harbored. This method has proven satisfactory and economical. It is stated in the report of the Spe-

cial Panama Canal Zone Commission, made to the Secretary of War: "We know of no city in the United States that is as clean as Panama, nor where the flies and mosquitoes are so scarce. . . . The alleys and yards are as clean as the main streets." These same conditions apply in general to the Canal Zone.

In Santos, Brazil, a city of 40,000, every house has water, sewerage facilities, gas, electricity, and a telephone. This is the more striking when it is remembered that 70 per cent of the population is engaged in manual labor.

Dairy cows must be tuberculin tested in Havana, Panama, Rio de Janeiro, Buenos Aires, Antofagasta, and Lima. The entire time of the force in one laboratory of Rio de Janeiro is given to examining and testing of milk. Port of Spain, Trinidad, uses a large amount of condensed and powdered milk. The rules of a private dairy in one city are so strict that a visitor is not allowed to enter the dairy until his shoes are washed in an antiseptic solution.

I was impressed with the need for a revision of maritime quarantine regulations. The civilized countries of the world have put into practical effect scientific discoveries for the control of certain communicable diseases. Many great ports have been freed from bubonic and other plagues and, in justice to them and because of the need of commercial expansion, there should be international quarantine laws which would take into account the convenience of the traveler and the extension of social and commercial relations. There should also be provision whereby public travelers may be assured that the ship or train is supplied with potable water.

II. MEDICAL SCHOOLS

The most gratifying result of the trip, to my mind, is the wider knowledge which was gained of the excellence of the medical colleges of the countries visited. The medical course in all of the schools consists of six years' training. With one exception, Cartagena, the colleges are well equipped, and have excellent laboratory facilities. In Cartagena two years of the course is devoted to tropical medicine and diseases, and sanitation.

In the Medical School in Caracas there were three hundred students, sixty in the senior class. Their training in tropical medicine and sanitation is obtained in the hospitals.

Brazil has five medical colleges, an Institute of Tropical Medicine, and there is to be established a special School of Preventive Medicine. All kinds of biological products, except salvarsan, are manufactured in the Institute, including snake-bite serum. Large quantities of these products are exported. A library, printing plant, and a box factory are part of the facilities of this institution. São Paulo has a modern laboratory at the Snake Farm where biological products are manufactured. They specialize in serum for snake bites.

The Medical College of Buenos Aires occupies an entire square of ground with complete equipment and an extensive library. This college has medical, dental and pharmacal departments, and a school for midwives. At present there are 4,000 students enrolled, many of whom are women. The laboratory, owned and operated by the Republic, is the most complete in the world. It is three stories high, built of stone and concrete. All biological products are made here, and they are dispensed free of charge. This laboratory produces over a million dollars' worth of products annually. Ample funds are provided by the Congress and it receives large amounts from private sources.

The medical department of the University of Chile, at Santiago, has fine buildings, a large lecture amphitheatre, modern anatomical rooms and a good library. There are twelve regular professors and forty-five assistants. Dr. Arturo Alessandri, the President of the Republic, is greatly interested in medical progress. With the Federal Department of Health he has written a new sanitary code.

The buildings of the Medical College of Lima, Peru, cover several squares. The departments are well equipped, and there are many able men on the Faculties of Medicine and Dentistry.

The medical men in charge of the medical colleges, and those we met engaged in public health work, were, without exception, cultured, scientific-minded, and enthusiastic in the cause of progressive medicine. To find the medical schools models of perfection, higher standards for the students as high as our own, was an agreeable surprise and an incentive to further efforts in behalf of our own colleges.

This tour, conducted under the auspices of the American College of Surgeons, is one of the most significant events in our medical annals. It implies an exchange of thought and ideas with the great medical colleges of the southern countries and a better understanding of the health problems of the world. It further implies more extended relations, medical and commercial, between the countries of the two continents which will be of reciprocal advantage.

ACTIVITIES OF THE HEAD SURGEONS

By JOHN F. BARNHILL, M.D., F.A.C.S., Indianapolis, Indiana

VERY soon after the departure of the *Vandyck* from New York, it was learned that a number of head surgeons were making the cruise to South America, and an inventory of the passenger list revealed that eighteen such specialists were on board. A call for a meeting was issued, largely for the purpose, it was stated, of promoting early and friendly relations among the Fellows. It developed, however, at this first meeting that not only did those present wish an organization that would be social in nature, but also, in so far as might be consistent with the utmost enjoyment of the journey, one that should be largely of a scientific nature. Accordingly an organization was proposed which would meet both scientific and social purposes.

Dr. John F. Barnhill, of Indianapolis, was unanimously chosen Chairman and Dr. L. deV. Chipman, of St. Johns, New Brunswick, was elected Secretary. At this time no name was given to the organization, as none was then thought necessary. However, at the last session, held just before landing in New York, it was suggested, in view of the fact that the members had taken such a lively interest in all the meetings held during the journey, and of the evident benefit received therefrom, that a name should be chosen, and a permanent organization effected. This was thought especially desirable since it seemed entirely probable that other similar journeys of the College would be made in the near future. After considerable discussion of proposed titles it was finally voted to call it "The Society of Head Surgeons, Section of Travel, of the American College of Surgeons."

The following surgeons enrolled as charter members of this section:

O. Miller Babbitt, Portland, Oregon
Ivan P. Balabanoff, Tacoma, Washington
John F. Barnhill, Indianapolis, Indiana
Rodolph Boulet, Montreal, Quebec
Frederick D. Branch, Binghampton, New York
De Witt C. Bryant, Los Angeles, California
Frank E. Burch, St. Paul, Minnesota
L. DeV. Chipman, St. Johns, New Brunswick
John H. Kincaid, Knoxville, Tennessee
George A. Leahey, Lowell, Massachusetts
James M. Patton, Omaha, Nebraska
G. William Schlindwein, Erie, Pennsylvania
Carroll Smith, Spokane, Washington
Frank M. Sulzman, Troy, New York
Lewis H. Taylor, Wilkes-Barre, Pennsylvania
Frank J. Van Kirk, Bellingham, Washington
W. E. Waddell, Los Angeles, California
John A. Winter, Duluth, Minnesota.

The Chairman in assuming the duties of his office made fitting acknowledgment of the honor conferred upon him by his confrères. He referred to the fact that a Committee on Scientific Meetings had already been organized for the purpose of presenting and discussing surgical subjects throughout the entire period of the cruise. In view of this general committee he was of the opinion that it would be a splendid thing for the members of the newly formed Head Section to attend all general sessions as well as their own, and he hoped all would avail themselves of the rather unusual opportunity to do so, for, he further stated, he fully believed that attendance upon the sessions of the general surgeons, and active participation in the proceedings, would be helpful not only to the head specialists, but to all, in that it would bring surgery of the different specialties into a more harmonious and helpful relationship.

During the cruise ten sessions were held. The subjects presented and discussed on the downgoing voyage covered a wide field and included nasal and sinus infection, pain from whatever cause, hæmorrhage from every source, and magnets and their use in ophthalmology.

On the return trip, very naturally and most helpfully, all discussions were carefully limited to observations that were made by the members at the various hospitals, medical schools and clinics of Latin America which were visited. One city at a time was dealt with, and comment and comparison was freely made of the men and methods in Rio de Janeiro, Buenos Aires, and Montevideo, with other men and methods which had been noted in similar clinics in cities of Europe and America.

In view of the fact that the Fellows were on a vacation, their attendance at all sessions and their sustained interest was little short of remarkable. Because of the promptness and evident enthusiasm with which all of the scientific programs were carried out, a Fellow of the cruise, evidentally in envy, dubbed the section "The Eternal Meeters." This title correctly described the conduct of the members, and they continued to merit it, so great was their loyalty to the last day of the voyage.

Through a misunderstanding, no clinics were provided at Rio de Janeiro for this section on the occasion of our first visit. The Fellows, therefore, employed their time in driving about the beautiful city, in attendance at general surgical clinics, and in visiting the medical school and the Oswaldo Cruz Institute. The chairman of the section called on Prof. Joas Marinho, a leading laryngologist and clinician, and Professor of Oto-laryngology in the Faculty of Medicine of Rio de Janeiro, in the hope that clinics might be arranged by him on the occasion of the return visit some three weeks later. Dr. Marinho, although in the midst of a busy afternoon's consultation, showed the visitor every

courtesy, and finally conducted him personally over the four separate floors of his office building used exclusively for laboratory and consultation purposes. The assurance was readily given that clinics would be arranged by him and his associates on the occasion of the return of the S.S. *Vandyck*. Accordingly, on March 28, on landing once more in Rio de Janeiro, Professor Marinho met our group and drove us to the San Francisco Hospital, where he and his associates conducted a clinic for the special benefit of the visitors.

The throat and ear department of this hospital is quite modern. Dark stalls are provided for individual treatment. Local anæsthetics are used almost exclusively in all operations, either in general or special surgery, thus giving the name, "The Local Anæsthetic Hospital" to the institution. In several cases tonsils were removed by the Sluder method, by assistants and medical students. The visiting surgeons were invited to operate, and Dr. Babbitt skilfully "Sludered" one case without an anæsthetic. Novocaine was used by injection in adults; and no anæsthetic was used for children. The tonsillectomies were cleverly done in all but one case, where a student left part of the capsule. Tonsil surgery was more up-to-date in Rio de Janeiro than in Buenos Aires, where, especially in children, the operators seemed satisfied to do the obsolete operation of tonsillotomy.

A new operation for the cure of ozena was demonstrated, the procedure consisting in opening both maxillary antra widely under the cheek, as in the Caldwell-Luc operation, curetting the mucous membrane, then incising the external nasal wall from above downward as far as possible, along the floor as far backward as possible, and then upward as far as possible, thus making a quadrangular flap with the attached base above. This flap on each side, with its attached turbinate, is then crowded over against the septum, which latter is first scarified opposite the turbinate. A heavy mattress suture is then passed from one antrum through both flaps, both turbinates and the nasal septum, being finally so tied as to hold the flaps and turbinates against the septum with which they are expected to unite. The cure is expected as the result of better nasal and sinus drainage and a greatly contracted nostril on either side.

A dexterous bronchoscopy was next performed, a new model of self-retaining laryngeal spatula being successfully used. The clinic was concluded by a splendid moving picture demonstration of the removal of a papilloma from the larynx by Dr. Marinho and his assistants.

The Fellows were well pleased with these clinics and showed their appreciation by a rising vote of thanks to Dr. Marinho and his corps of able associates.

Before reaching Buenos Aires our Fellows sent a wireless message to Dr. Arce, head of the committee that was to provide clinics for the visiting Fellows, stating that the subsidiary section of head specialists would appreciate any courtesies the eye, ear, and throat specialists of his city might be able to show in the way of special clinics. Accordingly much surgical work of the head, and especially of the eye, was provided by some of the leading teachers of this great clinical center. That the work in ophthalmology is well in advance of oto-laryngology was clearly evident. Dr. Burch, who made observations on the clinics of the ophthalmologists, has noted these facts. In some of the hospitals oto-laryngology has not as yet been fully recognized, and even in the teaching hospitals provision for the teaching of these subjects has but recently been made, and is not always fully up to modern standards. It was the opinion of all of our Fellows, and the subject was freely discussed on the homeward voyage, that oto-laryngology in Buenos Aires is from five to ten years behind the times, but that ophthalmology is fully up-to-date in every respect.

Enormous clinics in all these subjects were witnessed. The clinicians were skilful, rapid and dexterous. Practically all had received graduate instruction in France, England, or America. The backward status of the specialists was, therefore, not wholly due to the clinicians, but more perhaps to the restraint due to the newness of the work in a modern form. As in almost all surgical operations witnessed in South America, ear, nose, and throat operations were performed without nurse assistants, and often without any assistant. The dexterity with which many operations were performed under such circumstances appealed to the visitors as rather remarkable. Tonsil, septal, sinus, and even brain operations were performed with either no assistants or but one assistant, the surgeon preparing the patient, attending to the sterilizing of material, and even to the threading of the needles. In Montevideo the clinics were equal and similar to those of Buenos Aires.

On the whole the Fellows of the head section felt that they had been well repaid for their visit to the South American clinics. While some criticism of methods was made, all conceded the warmest praise for the clinicians, for their kindly consideration of the Fellows in the clinics, and for their hospitality in general. Undoubtedly all will for a long time remember the joys of the journey, the spirit of the surgeons who so willingly provided clinics, and the very generous hospitality of all the people.

OBSERVATIONS IN OPHTHALMOLOGY

By FRANK E. BURCH, M.D., F.A.C.S., St. Paul, Minnesota

At the time of our cruise, there were in the countries visited only a few Fellows of the College who practised ophthalmology, and our opportunity for observing eye work was therefore limited. Our visits, in most instances, were unannounced, but we were received with a cordial welcome everywhere and we observed the routine work of the clinics.

Most of the men we met had received their training as assistants in the local hospitals and clinics, with supplementary training in France, Germany, or Italy. In Havana, Panama, and Caracas we met men who had received their post-graduate training in the Eastern cities of the United States. There was no systematic post-graduate teaching in any of the cities visited. Undergraduate teaching of ophthalmology, at least in the universities of Brazil, Argentina, and Uruguay, usually includes attendance upon lectures and clinics for a period of 3, 4, or 6 months, as a rule no special examination being required. However, in Buenos Aires, the examinations in general medicine and surgery often include questions pertaining to ocular diseases.

Hospital records were good, especially so in the eye wards of the Ancon Hospital in Panama, and at the University Clinic and Hospital Optalmologici of Buenos Aires. The last mentioned was the one institution visited in which only eye work was done. Built at a cost of $800,000, containing 120 beds, with spacious wards, consulting and examining rooms and out-patient departments, it was a surprising revelation in hospital architecture, probably unexcelled anywhere. The out-patient attendance was 600 daily, the most prosperous looking recipients of charity we had ever seen. No private work is permitted in this or in any other *public* hospital.

The Staff consists of fifteen attending surgeons under the able directorship of Dr. Adolfo Oyenard. All are alert, young, progressive surgeons doing a quality of work comparable with that to be seen anywhere.

This institution and its staff, while new and in a formative period of development, without adequate laboratory equipment as yet and no training school for nurses, but with no precedents to overcome, will undoubtedly develop into a great ophthalmologic center for special training in eye diseases. In the matter of operating rooms, careful preparation of cases, operative technique and surgical dexterity, the eye work compared equally with that observed in Continental or North American clinics. In the absence of trained nurses and training schools in the majority of South American hospitals, the surgical work observed and the evident results appeared truly remarkable to us. Like comment will apply to the hospitals themselves and to the men and the quality of work observed at the University Clinic and at the British Hospital. The latter institution has an excellent nursing staff and training school.

At the University Clinic, in the absence of Prof. Enrique Demaria, Chief of Clinic, in Europe, Dr. Atilio Tiscornia and Dr. Paul Aganaras, held an impromptu clinic in our honor. Prof. Pedro La Gleze worked and taught in this hospital for a quarter of a century. His remarkable personality and leadership in ophthalmology has been an outstanding factor in the development of ophthalmology in the Argentine, and in the training of the present generation of ophthalmologists. All of the men refer with highest respect to his great originality, clinical observations, and pathological research, as well as to his qualities as a great teacher.

Everywhere one noted excellent work under local anæsthesia. In practically every clinic visited, we found enucleations done under novocaine. Paraffin is preferred to other substances for implantation. Our visit to the pathological laboratory proved most interesting. Fine work was evident, specimens were well cataloged, and there was an excellent museum. Among other unusual specimens was one of intraocular hydatid cyst, completely filling the vitreous.

There is an excellent Academy of Ophthalmology of Buenos Aires which has collected and published its papers at various periods. A review of its bulletins and year books shows every evidence of progressive, scientific, and much original production in advanced ophthalmology, not fully appreciated by those not conversant with Spanish medical literature.

Much of the clinical work in Argentina and Uruguay has to do with trachoma and its sequelæ. Trachoma is not well controlled and apparently is spreading in many regions. We were told that in some of the Argentine states, approximately 70 to 80 per cent of the inhabitants are afflicted with trachoma, the provisions for inspection and exclusion of immigrants being more or less perfunctory. Unfortunately, Mediterranean emigration is bringing a serious problem to South American shores in the unchecked tide of trachoma.

Cataract surgery is very decidedly "orthodox" in type, although there are fewer iridectomies, and less use of capsule forceps and anterior chamber irrigation, than with us. There is no manifest enthusiasm over adoption of intracapsular methods of extraction, even of the Spanish method. The use of the conjunctival bridge in extraction is popular with many of the surgeons. One sees relatively more simple extractions here than in Europe or North America.

Elliot's trephine operation for glaucoma simplex and broad iridectomy for acute cases is the common procedure. On inquiry, cyclodialysis, sclerectomies and sclerotomies do not seem to be the vogue.

Muscle surgery is perhaps not as highly developed as one would expect considering the fact that nearly everywhere one found good records of muscle balance tests. One of the leading surgeons states that few cases are operated upon before the age of puberty, and that practically nothing is being done to train fusion. Practically all muscle cases are treated as out patients. The La Gleze tuck is still the favorite method in Buenos Aires. Tucking instruments do not seem to be much used. Tenotomies are perhaps still too popular.

In Montevideo, the principal eye clinic is that of Prof. Alberica Isola at the hospital Maciel, a large general hospital almost a century old. With kindly courtesy Dr. Isola showed us his clinic in operation, demonstrated most of the modern diagnostic instruments, including the red-free lamp, Cullstand ophthalmoscope and slit-lamp microscope. He also showed us a very interesting pathological collection. He is a strong advocate of foreign proteid therapy and tuberculin. Dr. Martin Martinez-Pueta, his assistant, is thoroughly up to date. In this clinic, as everywhere in South America, refraction work, at least in the public clinics, is largely carried out without cycloplegia, excepting with children, much as is done in Vienna.

In Rio de Janeiro, the University was closed at the time of our visit and Dr. Abreu Fialho, the chief of the department, was at his summer home in Petropolis. At the Santa Casa hospital, his assistants showed us many interesting and unusual cases, including the convalescents. The operative results were excellent. The equipment and laboratories were modern and all the evidence pointed to good diagnostic work. There were separate operating rooms for clean and infected cases. Considering the lack of nurses, one wonders how such excellent results are attainable. Apparently every surgeon learns to become self-dependent and there is a minimum of "handling." Perhaps we may learn something of value from these observations.

At the Policlinic in Rio de Janeiro we visited the veteran, Dr. Brasil, whose outpatient service is very large, with the usual South American percentage of trachoma cases. His results with simple extraction for cataract were very excellent.

In conclusion, one may infer that, with a proper command of the language and more time at one's disposal, much of interest might be seen, even considerable that is new, especially in therapeutics. We were firmly convinced that the near future will bring rapid developments in ophthalmology in South America. Surely, the sixteen ophthalmologists of the cruise party will return to their native shore with many pleasant memories of the courtesies extended to them, and a most favorable impression of the special work observed in this field of surgery.

LATIN AMERICAN HOSPITALS

By EDWARD I. SALISBURY, M.D., Denver, Colorado

ONE of the dominant features of the recent mission of friendship of the American College of Surgeons to our neighbors to the South was the study and observation of their institutions; and to the surgeon, the most interesting among these is the hospital.

In comparison with our own great hospitals we can offer a criticism or two, constructive perhaps; but on the whole we found in our casual survey much to admire, much to praise, and many things worthy of imitation.

The Latin American hospitals are sustained in much the same way as ours of the North. The government probably comes first in the support of hospitals. By government I mean either the central power or the state. The municipality as a rule does not maintain hospitals. This is due to the system of revenues and tax impost, which levies are collected by the central government. And indeed in many instances one or two port cities support the whole country. Appropriation is then made by Congress to finance the public institutions of the several cities. This system has given rise to a lack of civic spirit, as in every improvement and in every public innovation the cities look for governmental aid. Therefore, the greater number of hospitals are state or federal institutions.

The *beneficencias* are next in importance in the support of the hospitals. They are beneficent associations which derive their funds from contributions and endowments by public-spirited citizens, from legacies, from the revenues collected by theatres, lotteries and the like, all of which are often supplemented by the government in the form of allotments to cover any deficit in the budget or an allowance of a certain percentage of duty collections on a given commodity or luxury.

Foreign colonies maintain many institutions such as the French, Spanish, Italian, German, British, and North American Hospitals. These hospitals receive support from their respective colonists and are conducted as pay institutions. A discount is allowed to the members of the hospital association, and free treatment is given to the poor of the respective colony.

Another type of hospital is the private sanatorium or *Casa de Salud* (House of Health), usually conducted by individual doctors or groups of specialists who form a partnership.

The first three types of hospitals, as a rule though not in every instance, maintain paid staffs, from the Chief of Staff to the visiting and resident physicians and surgeons. These posts are sought often from the monetary standpoint, while the work is "farmed out" to younger men looking for experience under capable instructors. Of course, a paid staff is a great drain on hospital funds that would be available for other uses and extensions if the system common to us prevailed.

The pay departments of the public hospitals and of the private hospitals are usually open to any reputable physician or surgeon who wishes to take patients into the institution.

The administration of the hospital is left to a board, or *junta*, of individuals, usually including members of the medical profession who are locally interested in public welfare. This board appoints a superintendent and assistants, matrons, nurses, attendants, etc. Often Sisters of Charity or of the other religious orders supervise the hospitals; but nowhere are hospitals conducted in buildings that are the property of the sisterhoods as is the rule in the United States and Canada. This custom may not have prevailed originally, but the property of religious orders has since been taken over by the state, and the sisterhoods are allowed maintenance and pay for the services of their individual members who do charitable work.

Training schools for nurses, with two or three year courses, exist in many of the hospitals. In some cities only one hospital has an accredited school which supplies nurses to the other institutions.

The hospital buildings are commonly one-story structures with high ceilings, well lighted and ventilated. Each ward is a distinct building and is separated from the other units by garden courts which add beauty and charm, and give surroundings that materially aid the patients in convalescence. The wards are connected by verandas which make for service and efficiency. Occasionally the hospitals are built on the isolated pavilion, or Virchow, plan with subterranean connections, as with the Pareyra Roselle Hospital of Montevideo and the Calixto Garcia Hospital of Havana. In the latter, however, the original plan to connect the buildings has not been carried out, and there is difficulty in the movement of patients, food, linen, etc.

In almost every instance the equipment in the hospitals, especially in the operating sections and laboratories, is modern and adequate in every way. A custom common to most of the Latin American institutions, perhaps because of the absence of nurses, is the peculiar system in regard to drugs. By far the largest department of the hospital is the drug store. A large force is maintained in each, and all pharmaceuticals are manufactured on the grounds; drug mills, mixers and elaborate machinery are ever present in the *Botica*. From 300 to 1200 prescriptions are filled daily and the several remedies for the patient are placed at his bedside in lieu of a set of standard formulæ at the nurses' desk.

The kitchens of all the hospitals are examples of neatness and cleanliness, and apparently good, wholesome food is served. The beautiful white-tiled

kitchen in the Central Hospital of São Paulo, with its battery of large steam cookers and open hearth grills, is typical of any modern culinary department found in the North.

I regret to state that screening has been neglected in most of the institutions I visited, and goodly numbers of flies were in evidence.

Most of the wards were overcrowded, and it appeared that this was not due so much to the number of acute cases as to a certain oversight in discharging patients who are able to leave the hospital. In late convalescence they hold many patients longer than we would do ordinarily.

Interesting, indeed, is the history of the hospitals of our Southern neighbors and the transition that has slowly taken place during the centuries. Every hamlet had and has today its hospital, something that cannot be said of our own country. A century before the Pilgrim Fathers landed at Plymouth, Panama had its hospital; but that was destroyed by Morgan when he burned the city. Two decades later, just 380 years ago, Bras Cubas "Fidalgo do Puerto Portugues" established "La Santa Casa da Misericordia" in Santos, Brazil.

From their resting place in the safe the *Administrador* of this hospital brought forth and showed to me the original *compromisos*, or articles, written in old Portuguese, establishing this ancient hospital. Parts of the old buildings are in use today. The history of this hospital is the common story of all. Many began in monasteries and a section was set apart as a hospice (hence the name hospital). Daily the poor or travellers came for food. If they were sick they were taken in. As the monks were skilled in the treatment of wounds, they were sought by the *conquistador*, the soldier and the mariner. Later the sisterhoods came, and the Sisters being by nature better adapted to the care of sick and indigent, the institutions became almshouses and sheltering homes. As time went on these places "specialized." Some became orphanages and some asylums for the aged or for the insane; something of a hospital was left for the sick. None but the poor entered, as the better classes were treated in their homes. Then came the wars for independence. The wounded soldier was brought into these institutions which often served as barracks as well. The early days of the republics found many poor. During the troublous times the gentry left the farms of plenty and took refuge and protection in the city. The men died in battle and the countryside was deserted. The capacity of the hospital was strained and the few Sisters could not care for the innumerable patients. The poor came in to help and they were the first class of lay nurses—menial laborers, nothing more. They were poor and untrained, and as the successors of these people came they were poor also and so uneducated. Thus nursing has not risen to a profession of highly trained and educated women as we know it to be.

The period of transition is at hand, for, mark you, the science of medicine and surgery has advanced and hospitals cannot be conducted without trained help. Not only is this true, but the home is no longer considered a desirable place for the sick. Our Latin American friends realize this and three important advances have been made: first, hospitalization being necessary, the better classes must be provided for, and as a consequence we find private hospitals springing up. The nurses are trained by the doctors in charge in much the same way that a stenographer in a doctor's office is trained to be an office nurse; second, to provide better trained help for the public hospitals, training schools have been started, and to be sure the first students are from the humble classes with only meager primary schooling; lastly, and most important to my mind, the middle classes, who cannot afford the private hospital and who do not wish to be considered paupers and be admitted to a public ward, must be provided for, so *Pensionadas*, or pay departments, have been established in the public hospitals. They are termed, according to their ability to pay, as first, second, and third class, and are given private, semi-private, or small ward services.

This, I think, shows a trend in the right direction. The public will soon be fully cognizant of the advantages and protection of the hospital and demand good nursing. This in turn will raise nursing to the dignity of a profession with a consequent demand for educated women of the better families, and it will encourage women in general to enter the professions and participate in public affairs. Even today the upper classes are taking an interest in nursing. Since the World War the work of the Red Cross nurse has created in the minds of the people a new and favorable impression of the trained nurse. Local chapters of the Red Cross have been established in the various Latin American countries, and now we find the wives and daughters of prominent families studying nursing in the day schools of the Red Cross, that they may go out and assist in public health and welfare work.

Many of these women have taken an active interest in Child Welfare and assist daily in the nurseries or milk stations where infant feeding and hygiene are taught to poor mothers. In Santiago, Chile, there are eleven of these stations, called *Gotas de Leche* (Drops of Milk), and they are doing a very laudable work.

All, I think, in time will lead to the desired result, viz.: A standardization of all hospitals such as we have today in the United States and Canada.

Space will not permit me even to enumerate the many hospitals that we visited in fourteen prominent and many lesser cities in Latin America. Everywhere that we attended clinics we saw the highest type of work and learned many things of interest. We saw many of the best surgeons operate in well-appointed clinics under ideal surgical asepsis, and with classical technique. We have returned, enriched in wisdom in many ways; and we have discovered clinics that we can visit with profit again and again.